THE CONQUEST OF LIFE

SERGE VORONOFF

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The Conquest of Life

Serge Voronoff.

Dr. Serge Voronoff.

The Conquest of Life

By

DR. SERGE VORONOFF, M.D.

Translated by

G. GIBIER RAMBAUD, M.D.

1928

BRENTANO'S

Publishers: New York

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Manufactured in the United States of America

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TRANSLATOR'S INTRODUCTION

ALL those who know Dr. Serge Voronoff cannot have failed, when they first met him, to be struck by his strongly marked personality in contrast with the great simplicity of the man, his quiet, unassuming manner, his kindness which, at once, attract one's sympathy. And yet, there is hardly anyone, today, who has not had occasion to hear or to mention his name, for, within the last six or seven years, few men have been talked about as much as he. And this, notwithstanding the fact that he has always tried to avoid publicity.

But the nature of the savant's discovery was such that it could not well be kept within the confines of the scientific world: the light could not long remain under a bushel!

The first announcement of that discovery was made by its author on October 18th, 1919 in the great amphitheater of the Paris Medical Faculty, before the 28th French Surgical Congress. It could be resumed in a few words: I have found a remedy for old age. I have already rejuvenated a number of animals.

Then, three years later, before a large audience gathered at the Laboratory of Experimental Physiology of the College de France, during the session of the 31st Surgical Congress, he presented one of his first rejuvenated human patients, Sir Arthur Liardet. Of course the press of the whole world published echoes of that communication and a flood of comments was let loose. Indeed, had it not been man's dream, throughout the ages, to extend the limits of old age and delay the advent of death?

Thus far, however, all communications regarding his work have been made by Dr. Voronoff before medical or scientific bodies or have been published in technical books intended for scientists. Within the last two or three years, interviews have been published in different papers and magazines; but as it more or less frequently happens in the case of interviews granted on purely scientific subjects, errors are bound to creep in and thus the facts become somewhat distorted. So that, of late, public interest having been greatly aroused, Dr. Voronoff was frequently asked by his lay friends, by patients, to write a book which they could understand and appreciate and which would be welcome by the general public which, after all, is keenly interested in all that is done for its welfare. This book is the outcome.

Within the few days which followed its coming out, the publisher received a number of requests from foreign firms for the rights in their respective countries. The first cable came from America. And when the publisher consulted Dr. Voronoff, the latter did me the signal honor of asking me to translate his book into English. "You have lived in America for twenty-seven years," he said, "you have worked with me for the past year, you know practically every detail that is dealt with in my book: I therefore consider that you are eminently qualified to accurately interpret my thoughts and translate my writings for the people of your adopted country." Of course I accepted and I hope I have not failed Dr. Voronoff's trust.

I also hope that his aim in writing this book for the laity will be fully attained: that is, to contribute to the better knowledge that man should have of himself and to shed the true light on the results reached and to be reached by the practical application of his discovery and of his method; they are exceedingly interesting from the purely personal human point of view as well as from the general economical standpoint. Indeed, the results obtained by Dr. Voronoff and his pupils among the herds of the French Government have deservedly attracted the attention of several foreign Governments which recently sent official missions to Algeria to observe these results and learn the Voronoff method of grafting animals and improving the qualities of different races and breeds.

As to the application of the method in human beings, I firmly believe that it will soon become more generalized, provided that the source of the necessary material — the monkeys — may be sufficiently abundant.

At the present moment, the patients, in ninety-eight per cent of the cases, do not want the fact that they have been grafted to become known. That is because of the special and wrong interpretation that has so often been given to the chief purpose of the operation. This is duly dwelt upon in this volume. But time will modify this feeling and I, for one, when necessity will make itself felt, — it may be soon, . . . who knows? — will not try to hide the fact that "I have practised what I preached;" for I will certainly desire to maintain my modest intellectual faculties as long as I possibly can: a most legitimate and least shameful desire, it seems to me.

Though not wishing to make abuse of the reader's time and of the privilege accorded me, I must add one remark. A great many people have asked me: "May not the introduction of a monkey's gland into the human organism lead to the development in the bearer of some simian characteristics, and so affect possible future progeny?" This question always brings a very broad smile on my face; and yet, it may be quite natural on the part of the non-initiated to entertain such apprehensions. My reply is: "Emphatically NO; for there is no direct connection between the implanted monkey gland and the excretory canals through which pass the genetic elements secreted by the man's own sexual glands. The same applies in the case of women. The effects of the graft are solely due to the internal secretion (hormone) of the implanted gland, the life and activity of which are maintained by the blood circulation established between it and the human tissues on which it is implanted. It is this internal secretion, this hormone, which, constantly thrown into the general circulation, acts on all the other glands and organs of our body. There is no more danger of causing a man to develop simian characteristics through the implantation of a monkey's gland according to Voronoff's method than of his developing sheep's or calf's, or any other animal's traits, after the subcutaneous injection of adrenalin, of orchitic extract, or thyroid extract, or pituitary extract, etc., prepared from these animals' glands." In fact, the reader will gather from the following pages a very clear comprehension of our several internal glands, of their functions; that the chemical composition of their secretions is respectively the same in man and animals and that the implantation of a monkey's gland acts on the human organism exclusively through its chemical constituents and not at all through its anatomical elements.

GEO. GIBIER RAMBAUD, M.D.
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CHAPTER ONE

The Cause of Old Age and Death

THERE is a decided discrepancy between our intense desire to live and the afflictions of old age and brevity of life. We have the natural impulse for living; but we instinctively desire to ward off death.

Every human being dreads the advent of death and suffers at the very idea of the physical and moral deterioration that comes with old age.

Religion itself brings us only trifling consolation. It can only exhort us to fortitude before the inevitable, and, in order to attenuate the horror of death and to satisfy our innate craving to live, to live for ever, it promises us that we shall be reborn in another world to life eternal. In its infinite commiseration for poor humanity which nothing is able to console for the loss of life on earth, religion has even deemed it necessary to assert that "the life beyond the veil" will be infinitely better. This, however, satisfies nobody. Believers and unbelievers alike call on God or on Science to prolong their existence on earth, and spare them the pitiful infirmities of old age.

Unfortunately, until recent years, Science was impotent to furnish any remedy for old age and postpone the fateful end. We knew the indirect causes of senility, the effects of certain diseases, but we were absolutely ignorant of the inmost reason for the deterioration of our organs which inevitably occurs at almost an exactly fixed period. Beyond the known commonplace causes of death lay a vast unknown. Could we reach it and penetrate the mystery of our organism, and get to know the primordial cause of old age and death? The solution alone of this problem, by unveiling Nature's secret, might guide us towards the possible remedy against the senile condition of which our body so often presents the lamentable spectacle at a certain age.

Difficult as it is, this problem must not be regarded as above and beyond the limits of possible scientific research. The impossibility of knowing the origin of life and the appearance of the first living being should not exclude the possibility of discovering the cause of death.

As a matter of fact, the origin of life dates back some millions of years, and it is at present impossible to reconstitute the atmospheric conditions — heat, moisture, composition of the air, radiations — as well as the very special state in which matter was at that period and which rendered the birth of life possible.

Death, on the other hand, is a phenomenon which happens before our eyes, and we have only too many opportunities for observing it. Our studies of it may extend from the most simple beings to the most complex organisms. We can even verify by experiment hypotheses suggested to us by observation, for if it is impossible for us to create life artificially, we are able to realize artificially the conditions that bring us near death or remove its danger, and non-success of previous investigations should not discourage any new effort that may tend towards solving the gravest and most poignant problem facing mankind.

The question arises at the outset: Is death inevitable, and must it be accepted as a general law from which no living being can escape?

I am speaking, of course, of natural, physiological death, and not of death arising from accident, malady or aggression by the stronger, all causes which are frequently observable in nature. I do not know whether this natural, physiological death has ever been observed in connection with mankind; for, post-mortem examination of even those who die in extreme old age, from no apparent malady, reveals lesions that have until then escaped observation, thus proving emphatically that death has resulted from more or less serious affection of certain of the organs.

If, then, natural death exists — and it is impossible not to admit that it does — it must be extremely rare *at the age at which it habitually occurs.*

In order to study this phenomenon and secure some clue to Nature's original intentions, the most logical method obviously is to base our investigations on the simplest category of beings, the ones nearest in character to those which first appeared on the earth. Only in this way shall we be able to glean some idea whether death was brought into existence at the origin of life itself, and whether it constitutes the unavoidable law of Nature.

Now, the most elementary kind of living matter takes the form of cells composed solely of protoplasm, a soft tiny mass, enveloping a nucleus. Such cells constitute the infusoria, the amoebae and other protozoa. While observing them we see each cell soon divide into two parts, each forming a living cell, without the least particle of the matter composing the original cell being lost. Each of these two cells divides again into two, and at the end of a very short space of time we see them reproducing themselves by division and increasing in an extraordinary fashion. Generations succeed each other with great rapidity, without a single case of death occurring. One seeks in vain among the innumerable swarm of infusoria for a dead organism. (Metchnikoff and Metalnikoff.) They would be capable of invading the entire world if, being deprived of defence, they were not devoured by multitudes of enemies.

The protozoan knows nothing of old age, and it never dies. It may be destroyed by adversaries or as the result of inanition, through lack of food, but it does not know physiological death.

In creating the first living beings, which, by gradual evolution through millions of ages formed themselves into the animal chain, Nature willed that they should be immortal.

The breath of life which, for the first time, animated matter contained nothing but life. Nature, at that period, was ignorant of death. What circumstances, then, brought about the fatal change in the original plan?

In order to comprehend this, we must follow the evolution which occurred in the constitution of living beings.

During the progressive course of the centuries, with the modifications that occurred in conditions of existence, and the changes in surroundings and habitat, certain primitive cells, associated themselves together, for the purpose of forming beings endowed with more perfect organs, better adapted to the new vital needs. These groupings, however, did not modify the essential quality of the primitive cell. The cell of no matter what part of the body was able to reproduce the entire body.

As a matter of fact, many of the lower animals have retained the faculty of rejuvenating themselves, of entire rebirth from any part whatever of the body: such is the coral, which multiplies indefinitely and often forms reefs several hundred miles long. The fresh-water hydra (water-snake) possesses the same aptitude for regeneration; if it is cut into the smallest morsels, each tiny portion will reproduce an entire normal hydra.

Some animals which, on account of their organic structure, may be regarded as superior, such as the planaria, the fresh-water worms, are able to reconstitute a complete individual from every part of their body. A similar phenomenon is to be observed in regard to the sea-worms called nemertina. Even the common earthworm, which is endowed with a relatively high organization, has preserved this faculty: each fragment of its body can regenerate the complete worm.

As we rise in the animal scale, however, and follow the evolution of beings towards more and more perfected forms, we shall see that the cells of the body definitely lose this power to regenerate the whole organism. This loss of creative power does not occur suddenly. It is at first limited to the power to reproduce only the single organ of which the animal has been deprived. Thus, crayfish are able to restore claws that have been torn off, but not the entire animal. Insects possess the same aptitude for reconstituting their limbs, but this regeneration does not extend to the rest of the body. The lower kinds of vertebrates still enjoy this astonishing faculty, although to a lesser degree. The lizard, for instance, can restore a lost tail. The higher vertebrates, however, birds, mammals and man, are totally lacking in the power to re-create a part of their body.

What is the reason for this? Why do the lower types of beings possess the faculty of rebirth, of being able to regenerate themselves entirely by means of any one of their cells, while the higher animals, which have acquired perfected organs, are lacking in the same gift, to the greatest prejudice of the individual (although not of the species, the continuity of which remains always assured by specialized cells)?

We find the explanation of this phenomenon in the fact itself that these higher organisms have undergone improvement. To individuals of a primitive order, formed of a single cell and endowed with a complete life, with aptitude for growth and indefinite multiplication, have succeeded beings constituted by a grouping of several cells, equally sufficiently simple to retain the same powers. These have been followed by other beings, all more and more differentiated, endowed with organs designed to accomplish one special function, and who are consequently comprised of cells very far removed from the primitive type, of which each has had to acquire special qualifications to enable it usefully to play its part in the whole.

Thus the aspect of the various cells which enter into the constitution of our body is so different from that of the typical cell, the primitive protozoan, that in it the initial cell can barely be recognized. The study of the latter, however, as we rise in the scale of beings, shows us all the stages at once how the muscular fibers, the nerve cells, and so on, have been formed.

Nevertheless, however complicated, however perfected a being, such as man, may be, it comes from a single cell — the ovum, or egg. The transformation occurs proportionally as the initial cell breaks up and divides itself more and more, for the purpose of forming, little by little, the various cells which will enter into the composition of our tissues and organs. Modified to an extreme, incapable thenceforward of leading an independent existence and of proving self-sufficient, the life of these cells is ensured only by the mutual help of all the others in the organism. They form a society, a state, in which each one fills a special rôle destined to ensure the life of the whole of them.

The higher and the more delicate the function of each organ, the more perfected are the cells of which it is composed, the further they diverge from the primitive type and the more they depend on the work of the less delicate cells of other organs. Thus, as in human society, there is established in the human organism a selection, a hierarchy between the various elements which constitute it, from the humble intestinal cell which, so to speak, prepares our daily bread, up to the delicate and highly perfected cells of the cerebral substance which co-ordinate the labor of all the artisans of our organism, stimulating some, checking others and forming a kind of Roman senate, which governs our cellular republic.

By the side, however, of all these more or less perfected and specialized cells, by the side of these industrious citizens, each following a special craft, are beings that are incapable of accomplishing any function requiring a professional education. These cells, which are little differentiated, are the connective tissue cells. They creep in everywhere, and are found in more or less greater numbers between the elements of all the organs, without exception. These conjunctive cells form the plebians, a hardy and vigorous race which reproduce themselves with great facility. Sturdier than any of the other cells, they continually encroach upon the places occupied by the noble cells, which, sooner or later, wear themselves out, victims to the sacrifice of their independence which they gave up to the community by undertaking a limited rôle, a special function which contributes to the prosperity of the whole society but only to the detriment of their own means of resistance. The study of old age teaches us, in fact, that these conjunctive cells invade the tissues of our organs more and more. Autopsies of the bodies of old people invariably reveal the disappearance, the atrophy, of the differentiated and specialized cells, which are replaced by conjunctive cells — sclerosis (the hardening of the tissues) is thus brought about.

Now, in proportion to the diminution in the number of the cerebral cells, our cerebral faculties progressively diminish, for the simple reason that the connective tissue cells are quite unable to carry out the functions of the cells that have disappeared; the co-ordinating influence of the brain over all the organs weakens, and when the number of cerebral cells becomes insufficient, when our brain contains too great a number of conjunctive cells, incapable of ensuring the functional harmony of all the organs, Death strikes the body which has been deprived of guidance.

But the brain is not the only organ to be affected. I have mentioned it first because it is the most important and the most perfected portion of our organism. A similar phenomenon is invariably observed in all the other tissues. The atrophy of the functional element and its replacement by connective tissue is to be seen everywhere. Even the bones submit to the common lot; hence the fractures that are so frequent among the elderly. Part of the chalk thus set free passes into the circulation and settles in the walls of the arteries, which have already been impaired by the invasion of the conjunctive cells; this deprives them of their elasticity, hardens them and renders them friable and unsuitable to the nutrition of our organs. These lesions, which are commonly known under the name of arterio-sclerosis, are the most characteristic of old age.

The muscles, in their turn, suffer the same fate. The muscular fibers thin down; hence the muscular weakness which occurs even well before the decrease of intellectual activity. After sixty-five, muscular effort becomes painful, atrophy having affected too great a proportion of the muscular system.

In the liver, the cells responsible for the formation of sugar, the supply of bile and the destruction of poisons are replaced by conjunctive cells. The same thing happens in the kidneys, where the conjunctive cells finally obstruct the ducts designed to carry off the waste products of the organism. And the same thing occurs in all other directions.

Everywhere, in the tissues and in the organs, it is the conjunctive cell which, occupying at first a modest place, multiplies itself, takes the place of the atrophied noble cells and, incapable itself of fulfilling their functions, brings into an organized society a kind of anarchy which causes its death. The numerous works by Retterer, a convinced evolutionist, demonstrate that the noble cell transforms itself into a conjunctive cell: that is becomes debased, so to speak, in proportion as the conditions of nutrition become defective with age. This, however, in no way affects our thesis. The fact remains that, with advancing years, the number of noble cells, specially adapted for a vital function, becomes diminished and that they are replaced by connective tissue cells which are incapable of fulfilling the same function. Thence come the disorganization of the whole of the functions of the body, old age and death.

Here, therefore, is a phenomenon of a general order, which furnishes the key to the mystery and supplies the reason for our old age and our death.

The initial cause having thus been elucidated, there are certainly numerous *secondary* causes which are able to accelerate the senile condition and shorten our existence. Metchnikoff was quite right in drawing attention to the harmful effect of fermentations due to the bacilli of the large intestine. The poisons which they elaborate, and which are reabsorbed by the blood naturally affect the most delicate, vital and sensitive — and the least robust — elements of our bodies. The same observation may be made in regard to alcohol, but with this extension: that the poison, which is the product of the fermentation of yeasts, seems even to super-excite the activity of conjunctive cells, thus bringing about the speedy hardening of the blood vessels and of the organs in general. It is unnecessary to remark that all infectious maladies have a similar effect.

There is no need to continue further. What we have wished to establish is the fundamental processes of all old age ending in death, namely, the predominance of conjunctive cells replacing highly differentiated cells — a veritable triumph of anarchy, an ephemeral reign of inferior elements — from which results the disorganization of all the functions and the final death of the organism.

CHAPTER TWO

The Role of the Internal Secretion Glands

IS IT possible to find a remedy for old age resulting from the atrophy of the noble cell, that has been replaced by a deficient and indifferently evolved cell? Are we able to at least slow down and delay the debasement of the most precious elements of our organism and thus prolong our youth, shorten the period of old age and postpone the advent of death?

A priori, we might hope to be able to do this, since we are often able to emerge victorious even from sharp conflicts between life and death resulting from infectious diseases. Unfortunately the situation is far from being the same in both cases. When we are dealing with an infectious disease, we have to contend with a foreign enemy in the form of microbes that have come from outside, and the steps we are able to take may tend to destroy the intruder whose death enables the patient to escape with his life. Such is not the case, however, with two cellular elements which form an integral part of our own organism. The situation is aggravated, too, by the fact that the conjunctive cell becomes harmful only when it replaces the specialized cells of our organs. Originally, it enters into the constitution of our body as a useful element without which we cannot do. It is the connective tissue, in fact, which forms the supporting framework for the other tissues and serves them as an intermediary for the passage of liquid nutriments. The blood vessels, the nerves, the muscular fibers, as well as the cells of all the other organs, are held together by the connective tissue, which forms a kind of solid framework, necessary for the maintenance of the edifice. We must not, therefore, find a means to destroy the conjunctive cells, as we have to do in regard to harmful agents which come from outside.

But if we have to be very circumspect in our action against the conjunctive cells, it would appear to be logical, on the other hand, to concentrate all our efforts on reinforcing the noble cells, increasing their vitality and their resistance, in order to prevent them from becoming atrophied and from being replaced by the conjunctive cells, the agents of our old age and death. Do we possess the means to do this?

From time immemorial methods for rejuvenating aged organisms have been sought for. Quite apart from the alchemists and the various more or less fantastic attempts made during the Middle Ages to discover the elixir of long life, serious thinkers such as Descartes and Bacon devoted themselves passionately to these researches. In our own period the illustrious biologist Metchnikoff, who was also a philosopher, believed that he had found the remedy against old age in the form of specially fermented milk (yogourt) with which to combat the harmful microbes of the large intestine.

Such milk, as a matter of fact, contains large bacilli which, innocuous for us, fight against the small and malevolent microbes that infest our intestines. But this remedy, like so many others, only belongs to the category of hygienic measures which it is as well to follow. It is in no way a panacea against old age, the profound causes of which have just been set forth.

What, then, would be the really efficacious means to combat the causes of old age? In order to reply to that question we must penetrate the innermost mechanism of our tissues and realize what governs their life and their functions.

Here we enter a domain that was still full of mystery up to barely thirty years ago. In spite of the fact that the study of the human body dates back for centuries, its essential mechanism remained unknown to us. It was well understood that from birth onwards each organ performed its part, that psychic functions were vested in the brain, that the heart propelled the blood through the vessels, that it contracted every second throughout a lifetime of eighty or ninety years, that the alimentary canal elaborated the substances we need for our nutrition, that the kidneys drained off organic waste, and so on; but we did not ask by what prodigious means each of these organs went on fulfilling its function unceasingly throughout our whole existence. Everybody, according to his religious convictions or his philosophical conceptions, sought the reason for this continuity of function — either in the will of the Creator who placed in us the principles of life, or in a sort of primary impulse which Nature bestowed generously on all its creatures.

Then, suddenly, there occurred a sharp awakening before a disconcerting reality, thanks to experimental methods the value of which was raised to a much higher level, especially by the genius of Claude Bernard. It was perceived that all that was necessary, in order to cause the brain to lose its psychic faculties and become incapable of forming a single thought, was to remove from the human body the thyroid gland, situated in the middle of the neck, far away from the brain!

But for the existence of this gland, the brain would be only an inert mass of grey matter and man would remain deprived of intelligence. In order that the brain cells shall manifest their activity, which is revealed by the transmission of a thought or a sentiment, there must occur in them a chemical reaction which is determined by the liquid secreted by the thyroid gland.

Children who are born without this gland, or in whom the gland becomes atrophied as the result of some illness, remain backward, or idiots, in spite of their cerebral cells keeping their normal constitution. The brain can no longer emit thought because it lacks the stimulant necessary for the launching of thought.

The brain-motor's ignition spark comes from the thyroid gland and, but for this spark (the thyroid liquid), it would remain inert. On the other hand, hypertrophy of this gland, the abnormal abundance of its secretion, over-excites the brain and the nervous system and brings about various troubles, such as trembling of the hands, and protuberance of the eyes.

Worse still are the results of the removal of the four little parathyroid glands, which are about the size of the head of a pin, and are situated alongside the thyroid gland. All the nerve cells are immediately thrown into wild over-excitement, marked by violent muscular contractions, and the patient dies in frightful convulsions within a few days. The nervous system, on being deprived of the secretion from the parathyroid glands, loses control of itself and of the equilibrium of its functions. It no longer knows what it has to do, so to speak, and instead of giving rise to regular contractions, adequate to the necessities of the moment, it provokes disordered movements, puts out of gear the play of all our muscles, and brings about death.

These little glands, then, are wonderful little factories in which is produced a liquid which is designed to moderate and regulate the activity of our nerve cells and to proportion their efforts to useful needs.

There are other glands which play not less important parts in our body. The loss of the suprarenal glands, for instance — the two little glands resting on the upper end of the kidneys — inevitably brings about death at the expiration, in the average case, of thirty hours. Extreme muscular weakness sets in, the beating of the heart becomes slower and slower, and the animal which is the subject of the operation dies showing every sign of extreme prostration, like men who are affected with Addison's disease, which is due to the slow destruction of these suprarenal glands.

Our heart, therefore, does not continue regularly contracting throughout our whole existence because of the first impulse given to it by Nature at birth. It is necessary for the heart muscle to be excited by means of a liquid secreted by the suprarenal glands, in order that it shall constantly maintain its beatings; it is this same liquid which maintains the rhythmical contractions of the arteries. The heart's dynamo is situated in the suprarenal glands.

Not less important is the rôle of the gland known as the pituitary body, or hypophysis, a little gland which is found below the brain, just above the roof of the mouth. About the size of a hazelnut, it weighs less than the fiftieth part of an ounce; yet its complete removal will bring about death within forty-eight hours, in some cases, and in five days at the longest. After the destruction of this gland an animal becomes somnolent, its breathing grows slower and slower, its temperature falls and it dies in a state of coma.

The effects on man of the partial hypertrophy of this gland have been studied. They are most curious and prove how the working of all our organs is controlled by the secretions of various glands, the most essential mechanism of our body.

Tiny as it is, the pituitary body is divided into two lobes, each of which has a special function. In a young person whose bones have not finished growing, hypertrophy of the anterior lobe of this gland provokes inordinate lengthening of the bones; the individual attains extraordinary height, his feet become enormous; the jaws acquire unusual proportions; there is enormous muscular development and the subject displays extraordinary strength. On the other hand, in the case of this anterior lobe's insufficient secretion the figure remains small, the feet and hands tiny, while the skin is soft and delicate.

The secretion of the posterior lobe has entirely different effects. It stimulates the breast and kidney secretions, influences the development of fat and stimulates the contraction of the visceral muscles.

There are other glands whose functions are still surrounded by mystery, such as the pineal gland, which is found in the middle of the brain and which was regarded by the ancients as the seat of the soul. What is certain is that, in certain reptiles, a third or middle eye has been found to have developed on the site of this gland. All that is known at present concerning the functioning of the pineal gland is in regard to its influence on the development of the generative organs; but further studies will be necessary for the purpose of throwing more light on the exact part which it plays in the organism.

I will intentionally leave aside for the time being the study of the genital gland, the description of which deserves more complete treatment. In the rapid glance which we have taken at the rôle of the internal glands in our organism, however, it should be emphasized that the life and the functioning of all our organs depends on them, and that it is these glands that regulate the action of each organ. Without them, the brain, the nerves, the muscles, as well as the liver, the kidneys and all the other organs would be unable to play any useful part. The removal of our stomach, of a great part of our intestines, or of a kidney would be infinitely less prejudicial than the suppression of the minute parathyroids, of the suprarenal gland, etc. The functioning of our organs depends directly on the activity of our glands, and when this functioning is interrupted the cause must be sought, in the majority of cases, not in the condition of this or that organ, but in the state of gland which regulates it.

Wonderful to relate, these glands have the same functions among all animals, secrete the same liquid and produce the same effects as in man. The internal secretion of a sheep's or a dog's gland is identical with that of a man, and if a gland from one of these animals were transplanted in the body of a man, it would have the same influence as his original gland of the functioning of the organs which it regulates. The reverse is equally true. If the gland of a man were grafted on any kind of animal, that gland would act like the animal's own original gland. The reason is that all these glands act solely by means of the chemical substance which they elaborate, and this substance is chemically the same in all subjects.

Where the difference occurs is in the various tissues on which acts this same liquid, their varying degrees of perfection, their evolution in the animal scale. The thyroid gland of a man, acting on the brain of a dog, would be able to arouse only the functioning of the brain of that animal in relation with the latter's own nature and to influence its capacity to manifest the thoughts and sentiments of a dog.

On the other hand, a dog's thyroid gland in furnishing to the organism of a man the chemical substance which the brain needs to enable it to perform its functions, would cause those functions to be fulfilled according to the capacity of human cerebral cells, cells brought to a degree of perfection that those of the lower animals have not reached.

Opotherapy, or treatment by glandular extracts, is based on these observations; it is to the glands of sheep, calves and other animals that we have recourse for the purpose of partially remedying the insufficiency of the functioning of human glands.

As minds gradually become convinced of these truths, medicine will gradually evolve in the direction of glandular therapy. With the exception of diseases caused by microbes, functional troubles of our organs are, in most cases, the consequences of disturbances in the glandular secretions. Such being the case, it is the cause of the malady that must be investigated, and not the harmful effect secondarily observed in the organ affected. Through profound knowledge of the effect produced by each gland, of the territory over which it acts, of the functions it holds under control, we shall be able to penetrate into the innermost mechanism of our organism and often master it.

These mysterious glands, so tiny in themselves, hidden deeply away in our tissues, avoiding investigation, remained unknown for centuries; during the whole of that unmeasurable period we remained ignorant of the essential mechanism of our body. One might almost think that Nature wished to hide her secret from us. Only painfully and after unceasing efforts, have we succeeded in wresting it from her.

How many diseases, not due to harmful microbes, have remained unknown to us owing to our ignorance of the rôle played by these glands! And what a marvellous opportunity we now have, through them, to bring about the restoration of equilibrium in the functioning of our organs.

For millions of years Nature has been groping her way, seeking, suppressing inapt organisms, and, little by little, has developed beings in whom all the organs are admirably combined for the purpose of ensuring a perfect functioning of the body adapted to the conditions of life on our globe. If in a normally constituted being, this functioning suffers disturbance, if our brain power diminishes, if our heart gives way, if our muscles weaken, it is because the gland that dominates the organ concerned has undergone some damage or some modification.

To be able to handle these glands as we choose, to ensure their vitality and the continuity of their action, to stimulate some, to *replace* others which have grown old and become worn out, is to render ourselves masters, so to speak, of our lives.

CHAPTER THREE

The Role of the Genital Glands

WE HAVE just laid down the ideal towards which our efforts must tend. We are, however, facing the inclemency of fate: the noble cells undergo progressive atrophy; the connective tissue cells which take their place become, in their turn, fibrous and sclerotic, imprint the marks of old age on our body and impel it towards the grave. The highest, the most perfected cells, those which are the most highly specialized for specific functions, which furnish the most intense labor, are the first to weaken and become atrophied and to be replaced by connective tissue. Now just think for a moment how high must be the degree of perfection attained by the cells of our glands, the size of which is often less than that of a hazelnut and sometimes still smaller! These glands necessarily contain only a limited number of cells which accomplish an enormous amount of work. The greater part of the time they share the work between them, forming themselves into separate teams, each charged with the duty of producing a different liquid intended to act on this or that organ.

Our salvation, the preservation of our youth and activity and of the harmonious equilibrium of all our functions can only be ensured if we can find the means to come to the help of the noble cells of our organs. Therein lies the most logical solution of the tormenting problem of our downfall, of our old age. This solution we may now be able to reach.

Nature, which created us to live and endowed us with powerful mechanisms with which to keep our organs in operation, has provided us, at the same time, with a wonderful source of energy. This rôle, again, was entrusted to a gland, for it is always the glands that are given the duty of producing the substance which has the power of influencing the various organs at long range — or even the whole organism.

Such is, indeed, the rôle of the genital glands, which distribute energy to and stimulate all the members of that immense hive which our body is, in which sixty trillions (60,000,000,000,000) of cells labor unceasingly, each fulfilling its determined function.

These glands elaborate the elements of future life which are destined to fecundate the ovule in order to give birth to a new being and to transmit to the species the creative energy held by the individual. At the same time, however, they secrete a liquid which, passing direct into the blood, carries to all the tissues the stimulus and the energy necessary to the individual himself.

In this we are able to observe a marvellous manifestation of the design of creation. In a single organ Nature has united the source of the life of the individual and that of the species.

This is confirmed by the fact that the emasculated male loses both powers at the same time. Henceforward incapable of generating a new life, he also finds his own profoundly weakened. This has been observed in cases of both men and animals.

Emasculation by deliberate surgical operation, therefore, enables us to study the rôle of these glands. It is practised on such a large scale amongst domestic animals, and even on men in the East, and has been carried out so often in laboratories by scientists anxious to study methodically the effects following deprivation of the genital organs, that a large number of recorded observations is available on the subject. The study of the phenomena thus observed demonstrates conclusively the influence of the internal secretion of these glands on the entire organism.

The removal of these glands reacts as much on the brain as on the heart, the muscles, the bones and all the other organs. The moral and physical energies both diminish, the peculiarly masculine qualities fade out of existence, youth disappears.

The caponized cock's comb withers away and the bird ceases to crow, and so on. It loses at the same time its fighting spirit, its courage, its instincts for domination and for protecting its hens.

The castrated bull, transformed into an ox, displays not only physical changes but also betrays the disappearance of his restless and suspicious disposition, his vicious temper; the once ferocious beast becomes the gentlest of animals; driven by a child it placidly draws a farm wagon, whereas, not long before, the strength of three men proved barely sufficient to master it. If one may judge by the external appearance of the brain, changes may even occur in the structure of that organ, in such circumstances. The brain of the bull has a glossy appearance, recalling the aspect of porcelain; the brain of the ox is a dead white, of rather a yellowish tint.

The spirited, capricious and difficult-to-manage stallion becomes, once castrated, the most docile of animals, and I have every reason to believe that in losing his genital glands he loses at the same time much of his intelligence. I draw this conclusion from the fact that in circuses, where wonderfully trained horses are to be seen, we find that the animals which have been educated to present such skilful steps are invariably stallions, and not geldings. The latter category, notwithstanding their perfect docility, always seem to be quite incompetent to understand what they are required to learn.

According to Kaddour, the head shepherd in charge of the flocks belonging to the Government General of Algeria, whom I met in that country, rams differ from sheep, both in their intelligence and in their altruistic sentiments. From observation of these animals extending over thirty years, he has noted that the ram always finds good pasturage more quickly and that as soon as the discovery is made he leads the flock there, which he will defend in case of need against the attacks of the smaller savage beasts. His castrated comrades, on the other hand, show themselves totally inferior to him in both circumstances.

The castrated sporting dog loses much of his hunting quality and is never the equal of the normal dog.

Castration also has an influence on the bony framework of animals. All the bones are slimmer. The cranial cavity is diminished, the face narrower, the chest contracted, while the legs are thinner and longer than those of normal animals. The muscles are less developed. Fat invades the body; this, by the way, being one of the reasons why animals destined to be utilized for food are castrated.

The flesh of bulls, rams, goats, boars, and other animals is deep red, firm, hard; while that of castrated animals is of a lighter and finer texture. The skin of the first-named animals is thicker and denser than that of the latter. Bulls destined for the butcher are castrated at the age of between ten and twelve months, while those intended to be used for working purposes are operated upon much later, in order that their body may fully develop and thus render them fit for the labor that will be demanded of them. Their strength, nevertheless, can never be compared to that of the bulls. The untameable character of the latter and the fierceness and violence of their movements render them unfit for field work. As to men, I made a very large number of personal observations during my stay in Egypt. Emasculated at the age of six or seven, eunuchs, when they reach adult age, present an entirely special aspect, which enables them to be identified immediately. Generally tall, owing to the abnormal lengthening of their leg bones, they possess wan, hairless, smooth faces, with drooping cheeks, which give them the appearance of old women. Generally corpulent, they have rounded figures and often overdeveloped breasts. Their flesh is flabby and their muscles are undersized. The voice is childish owing to the arrest of development of the larynx, and it is frequently discordant. The bodily strength being greatly diminished, they are incapable of furnishing any effort of a substantial duration. Their blood is poor, and anaemia still further accentuates their lack of strength. In short, physical decline appears to have affected every organ, and the eunuch gives the impression of being a fallen, languid individual whose vitality is much below par.

The intellectual and moral downfall is not less. The eunuch's memory is weak, he is much behind the other youngsters in remembering the verses of the Koran that are taught to him as well as to the other children. All forms of labor bring a hardship for him; he is naturally lazy, indolent and without energy. In him sentiments of affection are very slight, and selfishness is not one of the least of his defaults. Fearful as a chicken, eunuchs have little personal pride and are incapable of resenting an insult. They become prematurely old. At forty to forty-five their skin loses its suppleness and becomes scaly. After fifty years of age, the senile circle around the cornea — a sign of old age — is common. They rarely attain an advanced age.

Their intelligence is sluggish and never highly developed. They are often cunning, but is not cunning the sign of a weak mind? The few eunuchs who are cited in history as having played a certain part in ancient Byzantium were emasculated after they had already reached adult age and were able to preserve, for some years, at least part of the qualities they had previously acquired. Even under these conditions, the vitality of the organism was not maintained by the constant influx of stimulating energy, of which the reserve supply was soon exhausted, so that it suffered appreciable diminution. Abélard, the brilliant poet, never wrote a line after he was emasculated, by the orders of the cruel uncle of Hélöise, at the age of forty.

I have, moreover, received on this subject convincing confidential statements from men who have undergone castration late in life, whom I have had occasion to observe in France. Surgically deprived of their genital glands, on account of local tuberculosis, at the age of twenty or twenty-five years, these men, five or six years after their operation, noticed that they were suffering from defective memory, difficulty in concentrating their thoughts and in pursuing intellectual effort over a certain period.

During a lecture which I was invited to deliver in 1924, at the Catholic Institute at Toulouse, I learned from the ecclesiastics who, with their pupils, composed my audience, that canonical law prohibits an emasculated man from becoming a priest. This interdiction was imposed in consequence of its having been observed that a man who has been deprived of his genital glands loses not only his faculties for reproducing his species, which it is not the duty of a priest to exercise, but also some part of his intellectual faculties, which on the contrary, are very necessary to the pursuit of the sacerdotal office.

There is, therefore, no possible doubt as to the relation of cause and effect between the general depression of the organism and the disappearance of the internal secretion of these glands. As we have seen, no organ can preserve its vital energy and function to full capacity if its cells are not stimulated and vivified by the genital glands' internal secretion. Eunuchs furnish a very clear demonstration of this. All their organs are like those of the rest of humanity, with one exception. Deprivation of this one organ depresses, weakens the functioning of all the others and brings on premature old age.

The part played by the interstitial glands as the source of *energy for the whole of the human organism* is equally demonstrated by facts that are diametrically opposite to the foregoing in character. In fact, a series of observations regarding cases of men possessing three of these glands, glands of which one was of enormously increased volume, is recorded in the "Annales de la Medecine." Such was the case made public by Professor Marro, senior, of Turin, and studied at the same time by Professor Sacchi, of Genoa.

It was the case of a child of nine whose history is carefully given and accompanied by a characteristic photograph. At nine years of age this child possessed a fine beard and moustache, and had all the appearance of a young man of twenty. Short of figure, but very robust, he had strongly developed muscles and gave the impression of a vigorous man. His intelligence was equally far above that of an individual of his age.

The parents, alarmed by the unusual aspect of their child, had the hypertrophied interstitial gland removed. Some months after the operation the beard fell out, the lad's muscles diminished in size, and, which is still more significant, his intellectual development underwent a regression which brought the child back to a state corresponding with his age.

We have in this case an excellent demonstration that the orchitic glands not only hold under their domination the factors connected with sex, but that they certainly act as a general stimulant of our physical and intellectual energy.

In women the ovaries fulfil a similar duty to that of the interstitial gland in men. The profound perturbations that occur in young women, after undergoing the operation for the removal of their ovaries, is well known, and so, too, is the change that occurs in appearance of women after the change of life, when the ovaries cease to function. This is the beginning of old age.

Cases of children are also on record in which the hypertrophy of one ovary has resulted in phenomena analogous to those observed as the consequence of the hypertrophy of the orchitic gland. "La Presse Medicale," for instance, published on December 5th, 1923, the picture of a child aged three years and eleven months, who, under the effect of a hypertrophied ovary, presented the appearance of a young girl of fourteen! She had well-developed breasts, and had, for six months previously, manifested all the usual symptoms of puberty. The hypertrophy of one of the ovaries, with its consequent repercussion on all the other glands, which are closely interrelated, had resulted in the child crossing ten years at a single stride.

All this affords convincing evidence of the general rôle played by the genital glands in the human organism.

Decrepit old men are, in reality, eunuchs. They have been emasculated not by the criminal hand of man, but by the cruel law of nature, by the wear and tear of old age. When their interstitial glands ceased to function, when they lost affective ardor, there occurred in their physical, moral and intellectual condition a characteristic modification that made them, for all practical purposes, akin to eunuchs.

The great deeds of life, noble and generous actions, are performed during the activity of the sexual glands. How right Metchnikoff was when he asserted that a man of genius loses much when he becomes deprived of his genital function!

If Goethe, that universal genius, the author of "Faust," produced admirable works until the end of his days, if he displayed at the same time proofs of astonishing physical activity and energy, it was because he preserved the reproductive faculty down to the last years of his long life. This great genius was a great lover, like Victor Hugo — like all geniuses, in fact — but only the poets have the courage to tell of their loves.*

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* At the age of seventy-four Goethe was still ardently in love with a girl of nineteen. At the age of eighty, on his death bed, his last words were: "Look at this lovely woman's head, with black curls, on a black

The case of Goethe, except for his genius, is that of all men who, when they have attained a very advanced age, continue to manifest a splendid activity, a clear mind, affectionate and generous sentiments. Their interstitial glands, still possessing a sufficiency of active cells, sustain them in the love of life, to the exact contrary of the aged, whose glands have become atrophied.

In the manifestation of his intellectual and physical qualities, which differ according to the individual, man depends to a great extent on his interstitial glands and on their greater or lesser activity, which has a direct repercussion on all the organs in stimulating their functions. Unfortunately, this activity diminishes progressively with advancing age. It is at its highest during youth and adult age, at the moment when our organism attains its greatest strength and energy. Then activity begins to wane, and, at last definitely ceases. The diminution of activity corresponds to old age, its total disappearance to senility.

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background . . . " and he added, after a pause: "Licht, mehr licht!" . . . "Light . . . more light" . . . so that he evidently might better see this vision . . .

CHAPTER FOUR

The Influence of the Genital Glands on Longevity

IF SUCH are the effects produced by the genital glands, castrated animals and emasculated men ought not only to age before normal animals and men, but also to die before them. On this subject I have inquired among the professors attached to the State Veterinary School at Alfort, near Paris, and among veterinaries in Algeria, Tunis, Morocco and the French East African colonies, with whom I am in close relations in consequence of my experiments in connection with domestic animals.

From these inquiries I have learned that it is impossible to secure exact information concerning animals used for food. Sheep are sent to the butcher when between one year and six years of age; bulls are slaughtered when six years old, at the latest, and oxen are not kept alive beyond the age of ten to twelve years. The only animals on which systematic observations have been able to be made on this subject are horses.

I have received from veterinaries and from breeders the general affirmation that stallions attain a very advanced age, which is seldom reached by geldings. According to my friend, M. Trouette, the learned inspector of breeding in the service of the Government-General of Algeria, who is so competent on all questions concerning domestic animals, the duration of life of stallions is 25 per cent longer than that of geldings. Here, then, is a positive fact: a stud-horse lives longer than a castrated one.

To this I can add my own observations on the eunuchs in Egypt. During my stay in Cairo, I was constantly in touch with eunuchs, and I was present at the deathbeds of several of them. These men had all undergone surgical operations when quite young, and their organisms had never been submitted to the influence of the internal secretion from the interstitial glands. Observation of such subjects, therefore, is of very great value from the point of view of enabling us to appreciate the influence of these glands on longevity.

Let me state, then, that I have never known a eunuch to exceed the age of sixty. Well before death they have the appearance of old men, and from this one might be tempted to attribute a very advanced age to them; but this would be a pure illusion. They have every appearance of being effectively aged: dry skin, bloated body, dull eyes. They have a stooping gait which gives one the impression that they are centenarians. Their death seems to be the normal end of old age, but verification of the facts usually indicates that they die when between fifty and sixty years of age. Their aspect is the outcome of the fact that, deprived of the essential factor of youth and vigor, they have prematurely aged and have died well before the term ordinarily attained by normal men.

Thus, then, the lack of the internal secretion from the sexual glands shortens life. It could not be otherwise: it is unthinkable that a body deprived of the organs the suppression of which renders the blood poor, the bones frail, the muscles feebler, fat more abundant, nutrition imperfect, should not suffer a general enfeeblement, become more vulnerable and less able to struggle against all the causes which always bring about death well before the normal physiological time.

It may be affirmed, then, that deprivation of the interstitial glands' internal secretion accelerates the advent of old age and shortens life. On the other hand, the maintenance of this source of vital energy is the best guarantee of longevity. Men who are endowed with active interstitial glands and in whom the functioning of these glands is not extinguished, live to be very old. Victor Hugo and Ibsen remained ardent lovers down to the end of their long lives. Goethe, who completed the second part of "Faust" when he was eighty-two, fell passionately in love with Marianne Ioung, who consoled him for the disappointment he had suffered some years before at the hands of Ulrike Lewtzow, a young girl of twenty, whom he wished to marry. Thomas Parr, whose green old age was so astonishing that he was invited to London by the King of England at the age of 132, remarried when he was 119. When he died, at the age of 132 years and nine months, as the result of the too rich food of which he partook at the Royal Court, a post-mortem examination was made of his remains by the celebrated Dr. Harvey, the discoverer of the circulation of the blood. The report on this autopsy was bequeathed by Harvey to his nephew and has been published by the Sydenham Society. It sets forth that the organs were found to be healthy, and even the cartilages of the ribs were not yet ossified. The interstitial glands were "heavy and voluminous." Parr's wife asserted to Harvey that her husband did not cease to carry out his conjugal duties up to the age of 120 years!

Peter Albrecht, who lived 123 years, remarried in his eightieth year and had seven children.

George Douglas, born at Marstrend, near Gothenburg, in Sweden, lived 120 years and seven months, remarried at the age of 85, and had eight children. The last was born when he was 103.

These instances might be multiplied; medical literature contains an enormous number of them. Authors are unanimous in recording the preservation of the genital function among old men who have attained a very advanced age.

These facts lead to the logical conclusion that a close relationship exists between the maintenance of this function and the vigor and youthfulness of the body, the one being dependent on the other.

CHAPTER FIVE

Can the Duration of Life be Prolonged?

FROM the period of my observations among the eunuchs in Egypt, which revealed to me the importance of the internal secretion of the interstitial glands, I was haunted by the idea that it might be possible to gain control over this wonderful potential force, and utilize it for our needs when, as we advance in age, its natural source begins to show signs of exhaustion.

But, I asked myself, is not the whole idea chimerical? Powerful as the source of youth which we have discovered in ourselves may be, would it be possible, even when we have renewed it in our body, when we have restarted the production of this precious fluid, to instil increased vitality into the weakened organs and exhausted tissues of a body worn out by age?

Up to quite recent years scientists did not believe that this question could be answered in the affirmative, and they always advised poor humanity, thirsting with a desire to live, that it should accept old age without hope and die without revolt. This was the law of Nature, we were told, and we must submit to it.

Our minds cannot accept this verdict any longer, however, at the time when we are freeing ourselves more and more from the laws of Nature. Have we not vanquished the tremendous law of gravitation, which has condemned us, since the birth of humanity, to crawl along on the surface of the earth? We willed that we would rise into the air, and aeroplanes now carry us to heights that no bird can attain.

By the manner in which she has organized our lungs, Nature obliged us to live on the surface of either land or sea. We have contravened this law, and the submarine enables us to penetrate the depths of the ocean.

In the atmosphere that surrounds us Nature hid, like some mysterious treasure, impalpable fluids that bind the planets together. We have wrested this secret from her also, and through the hertzian waves we can now transmit our thoughts and our voices, and communicate with fellow creatures separated from us by thousands of leagues.

All human progress is due to the triumph of Man over Nature. Thus Man demonstrates his superiority over the rest of creation, and it is thanks to this superiority that he has arrived at his present stage of evolution.

But for the constant struggle against Nature, we should be still in the predicament of the cave man.

To subdue Nature is to ensure the progress of Humanity. Up to recent years this struggle was concentrated on the conquest of the mechanical and inorganic forces of Nature. We now have greater ambitions; we aspire to bring Life itself under the domination of our will.

This life is ruled by laws of which we have hitherto been ignorant, and our submission to them was the result of our ignorance.

To know is to set ourselves free; *to know* is to conquer; *to know* is to be the master of Matter, whether inorganic or living.

Now, we have seen what are the causes of our decrepitude and of our death: atrophy, the wearing out of our noble cells, the elements of our youth, and their replacement by conjunctive cells, the agents of our old-aging.

We have also learned what a wonderful source of youth Nature has placed in our interstitial glands. The veil is lifted from our brain, and we must have the daring, now that this knowledge has been acquired and this secret revealed, to force Nature to keep us young until the supreme moment when we must fade away into unknown parts of creation.

At no moment of our lives do the cells of our bodies remain immutable. They are constantly undergoing renewal. Younger generations are continually taking place of older ones. Without this faculty the continuation of life would be impossible.

Like the protozoa and other primitive beings, the cells of our body, after a short period of existence, divide into two, giving birth to two young cells which continue the cycle of division and of renewal throughout our whole life.

A typical instance of this uninterrupted renewal, which it is easy for anyone to observe, is offered by the hair and the nails, which continue to grow and to be renewed down to our death. The same phenomenon occurs in the interior of the body. Have we not all known cases in which a muscle, which has become atrophied as the result of long confinement to bed by illness, has recovered its normal volume under the influence of exercise, and even surpassed it?

This renewal of the cells does not cease with the approach of old age, but merely slows down. Why should we not be able to accelerate the cycle of renovation, multiplication and rejuvenation? The capacity possessed by our cells of living and renewing themselves is not limited by the actual intervention of death, as experiments have convincingly demonstrated.

As a matter of fact, if a portion of the skin, the liver, or the kidney, of any animal — a guinea pig for instance — be detached from the animal's body and placed in a nutritive serum which is frequently renewed, the cells of these organs, thus cultivated outside the body, recommence dividing and multiplying, the young always replacing the old. These experiments have become classic. At the Rockefeller Institute, Dr. Carrel has thus kept alive for the last twelve years cultures from the tissues of small animals which have been dead that long, and of which the life does not normally exceed three or four years.

The fact that cells cultivated apart from the organism to which they have belonged may live much longer than the same kind of cells remaining in the body itself proves clearly that death does not indicate the inevitable termination of the vital power of the cells, or the end of their faculty to multiply and renew themselves, but is solely the result of certain unfavorable conditions to which the cells have been submitted at a given moment.

The cells, it may be said, enjoy an infinite existence from the moment when they are liberated from their mutual subordination in such complex organisms as those of man and the animals. In these organisms their activity, their power to divide and to renew themselves must be constantly sustained by the internal secretion of the interstitial glands. As this secretion diminishes with age, cellular work diminishes to the proportionate extent, both in the organs and in the other glands which are so indispensable for the perfect functioning of the body. The falling off in cellular activity, however, is slow.

Until extreme old age the noble cells, which have preserved their vitality, continue their cycle of evolution and multiplication; but its rhythm is slowed down and ceases definitely at death through lack of the stimulant furnished by the glands.

If the exhausted source be replaced in time by a new interstitial gland, young, vigorous and in full activity, fresh energy to renew will be given to all the cells and their power to divide and renew themselves will be augmented.

CHAPTER SIX

The Struggle Against Old Age

BROWN–SEQUARD, the inspired savant who filled the chair of physiology at the College de France had already conjectured that there is a relation between old age and the diminution of the function of the interstitial glands. But that was in the Nineteenth Century, when the dogma still prevailed that Nature alone could endow a living being with the organs allotted to him.

The daring idea of associating ourselves with Nature in her work of continuing life was born of the Twentieth Century, which has already seen the advent of so many wonderful discoveries.

Brown-Sequard advised elderly men to have recourse to injections of the extract prepared from the orchitic glands. Dr. Lorand advocated the employment of the thyroid gland for the same purpose. The universal application of the Brown-Sequard method did not result in the success expected from it and is now almost completely abandoned. The reason for this is that the trituration of the gland does not permit the extraction of the whole of its products; active elements are quite scant in the liquid that is obtained. This liquid, moreover, like all organic extracts, rapidly undergoes changes, loses its properties and often becomes toxic. Its action, besides, can only be temporary. In our body, under normal conditions, our glands secrete continuously the stimulating liquid necessary to the organism. As soon as the glands no longer secrete it, it should, however perfect be its preparation, be injected in small doses, several times a day, throughout the rest of life.

Opotherapy, which is treatment by organic extracts, has had its day. It is a palliative, inadequate and indifferently efficacious method only to be employed when nothing else is available. It is a thing of the past. Our ambition now goes further. A worn out piece of a living machine must be replaced by a new piece. I was nursing this idea since my stay in Egypt, where I studied the eunuchs and their premature old age, due to the absence of the organs essential to youth. Everybody, at a given moment passes into the same condition as the eunuch, which condition is approached more or less at the same rate as age dries up the source of youth. After the age of sixty every one experiences lapses of memory, a disinclination to cerebral labor, a certain amount of stiffness in the joints, a diminution of muscular strength, of physical and mental energy and of effective ardor, the preludes to the condition of the eunuch.

There are certainly, however, individual differences. Better placed than anybody to make observations on this subject, I have seen men of fifty who were manifestly old, and men of sixty-five and seventy who were only then beginning to give the first signs of organic weakening. But Fate has so ruled that no person can escape the normal destiny. Sooner or later the interstitial gland ceases to function, the spark which furnishes ignition to the human motor becomes more and more faint, life slows down; we become old.

It has been said that it is necessary to know how to grow old, and that every age has its privileges; but what poor prerogatives old age has reserved for us! We are left with the joy of seeing the young enjoying their lives, we have the pleasing right of inspiring respect in place of love, the satisfaction of possessing tranquil minds and of being able to contemplate existence with a serene philosophy — because all our passions have died out! Which of us craves such advantages? Which of us would not rather conserve the intense and wonderful joy we derive from the expenditure of our energy, the strength of our sentiments, the ardent passion of our youth and our adult age? The alleged joys of old age have been imagined to console us in our downfall, which is considered as inevitable and irremediable. Well, as a matter of plain fact, this notion is entirely false.

We cannot avoid death, but we can nevertheless stave it off to the extreme limit of the possible; to do this, however, we must suppress old age, in much the same way as we can cure a disease.

By the grafting of interstitial glands, to which may be added, according to individual indications, that of the thyroid gland and of the pituitary body, we may be saved from old age and we can be given the joy of dying young at an age which is not at present reached even by very old men. My method is still too recent for me to be able to confirm this statement by giving an instance of a man remaining young up to the age of 150 years!

I have already been able, however, to give a manifest proof of the genuineness of my claim in regard to some animals, the life of which is very much shorter than ours and consequently easy to follow up. Thus I kept in my laboratory, thanks to a grafting operation, a ram which remained still full of vital energy up to the exceptional age of twenty years! That would be equivalent, if measured in the ratio of the years of normal human life, to the age of 160. As a rule, old age, among these animals, begins to set in at the ninth year, and they die completely senile, at the age of fourteen, at the latest. Their "old age," therefore, lasts about five years, under normal conditions.

My ram was grafted at the age of twelve years, while it had the appearance of a wretched and aged beast, and its decrepitude vanished as by enchantment. It maintained remarkable vigor up to the end of its long life. The ewe with which it shared the last six years of its existence gave birth to five lambs, the last of which was born four months after the *youthful* patriarch's death. Six days before its death, and not until then, the aged ram suddenly declined, lost its appetite, became drowsy — and passed away. Its "old age" lasted six days, instead of five years, in spite of the fact that it had exceeded by six years the life of the longest-lived individuals of its race!

The case of this ram indicates to us the course to be pursued, the ideal to be attained: the prolongation of the length of life and the shortening of the period of old age, thanks to gland grafting.

CHAPTER SEVEN

My Method of Glandular Grafting

THE realization of this glandular grafting has proved extremely difficult and has necessitated some years of research during which the will to arrive at a successful result required the support of a remarkable amount of patience. Even the grafting of plants is rather a delicate proceeding. First, a favorable period must be selected — preferably the Spring, when the sap rises abundantly into the stalks. Care must also be taken in choosing the place at which the new branch is to be inserted — preferably at the base of a young shoot — and, in every case, the barks must be adjusted in such a manner that the sap ducts of the tree or plant may penetrate the transplanted branch and supply it with nourishing fluid.

In the same way, animal and human grafts must provide before everything, that the sap, that is to say the blood of the bearer, shall penetrate the transplanted gland and furnish it with the nutriment without which the life of no organ is possible. This essential condition was never realized in the few human graftings attempted before I identified myself with this special surgery, and they all proved failures. These failures were due to the fact that the operators expected from the complex human organism something which they would never have been able to obtain from even a simple plant. In fact, they simply made an incision at no matter what point of the skin or muscles, and there placed the new gland. After so doing they waited for a miracle to happen; but it did not, for, in order to obtain a miracle, one must at least deserve it.

The transplanted gland, not being connected with either the veins or arteries of its new host, was unable to secure the blood necessary to nourish its cells; it constituted a dead body within a living organism which could not tolerate it. The glands thus transplanted were always reabsorbed and at the end of a few weeks, or at most some months, not a trace of them remained.

As a consequence of these unfortunate attempts a conviction, which was amply justified at the time, was established in the minds of physicians that grafting had no real value; or, rather, that such operations could not meet with success.

This opinion, which was based on facts actually observed prior to 1927, proved extremely prejudicial to me. The effect was that, when I had worked out, after hundreds of experiments on animals, a technic of my own which assured to the grafted gland an abundant blood supply and also its survival for several years, the doctors long remained incredulous. So far as grafting is concerned, some of them have retained the mentality of people who would have seen the beginnings of aviation at the time when a prize was awarded Santos Dumont for having made a hundred-metre flight and who would not have looked at a newspaper since. One can imagine their pitying smile at human credulity when they would be told that an aeroplane had made a non-stop flight from New York to Paris. But it is difficult to ignore the progress of aviation: aeroplanes make so much noise, whereas one seldom hears from men who have been grafted! *

Fortunately, authenticated records concerning men and animals who have already undergone treatment are so abundant and medical literature is so rich in documentary evidence and irrefutable proofs coming from countries where my method has been applied, that the number of people who are incredulous through ignorance is now very small. I say nothing of the jealous and the envious, who conceal their mediocrity by denying the discoveries which they have not made themselves.

The majority of scientists, however, took the stand that there was no reason why a new method should not overcome the earlier difficulties or why progress should not be possible in this direction. Many have come to watch my method of operating or have applied it themselves: these constitute the most convinced ones. Others have made themselves familiar with the numerous cases reported in the scientific journals and have modified their opinion. In reality, I have every reason to rejoice at the rapid change that has occurred in the mind of the medical world. One celebrated surgeon, Professor Tuffier, who has himself performed a large number of grafting operations, remarked to me in 1919, after I had presented my first communication on the method to the French Surgical Congress: "It will require thirty years to get your ideas into the minds of the doctors and convince them that you have got hold of the truth!" Well, the headway made

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* See the Introduction.

during the eight years that have elapsed since then shows me that Professor Tuffier's estimate was exaggerated.

We live in a century of rapid communications, in which thought speedily goes around the world and in which discoveries that are made in Paris are immediately commented on and verified in Japan as well as in England, in Australia as well as in America. I recently received a pressing invitation to send one of my pupils to Borneo where the natives, enfeebled and made prematurely old by the tropical climate, place on grafting their hopes of recovering their vital energy.

Requests for information in regard to the application of my grafting method for the improvement of various species of domestic animals have reached me from the governments of several countries, and notably from England, Italy, Spain and the Argentine Republic. I have even had the signal honor of being appreciated, before my death, in my own country! I had the supreme satisfaction of being present, recently, at a lecture delivered by the eminent Professor Sicard before the students of the Paris Faculty of Medicine, in the course of which he explained to them the details of my method of grafting. I was all the more gratified that justice was done to me in this same Faculty of Medicine where, seven years before, another professor, then president of the Surgical Congress, forbade me the opportunity of explaining my researches — under a fallacious pretext, but in reality because he wished to spare the learned assembly the pain of listening to things which, according to him, were "devoid of common sense."

Did not the Paris Faculty of Medicine, moreover, for twenty years deny Pasteur's epoch-making discoveries? The senior members of the profession may still recall the violent attacks that were directed against this man of genius at the Academy of Medicine by the famous Professor Peter, the obstinate defender of consecrated errors. Every man who makes a discovery finds himself faced by a Professor Peter. It is only the name that is different.

M. Leclainche, a member of the Institute of France, did me the honor, on August 22, 1927, to lay before the Paris Academy of Sciences the results of my grafting operations on the flocks of sheep belonging to the Algerian General Government.

The new edition of the "Traite de Pathologie Chirurgicale," published by Professors Beguin, Bourgeois, Duval, Gosset, Jeanbrau, Lecene, Lenormant, Proust and Tixier, introduces my method of glandular grafting into classical teaching. The Chapter devoted to this subject was written by Professor Jeanbrau, the eminent Montpellier surgeon.

I have followed the road opened by the illustrious savants Claude Bernard and Brown-Sequard, professors at the same College de France where I prosecuted my researches in order to transform dream into reality. I started from the principle that we must conform to Nature when we dare substitute ourselves for her. Now, it is truly not possible to suppose that Nature has put our organs in haphazard fashion, or that it is a matter of indifference whether they be in the situation in which we find them or in no matter what other place. Such belief can only be the result of our ignorance or of our presumptuous claim to be more intelligent than Creation. Yet, most of those who attempted glandular grafting before myself started to work on this basis. They implanted the interstitial gland under the skin of the abdomen, in the muscles, on the peritoneum, in the back, even in the marrow of the bones; in a word, everywhere except on the spot which Nature has assigned for these organs.

With more modesty, I conformed to Nature's design. I laid down as a principle that each organ we would implant in a living body ought to be put in its natural place, where thousands of successive generations have assured it the best conditions for its vitality.

I then proceeded to search for means to procure for the transplanted glands the supply of blood necessary to nourish them. The simplest way would be to bring together, end to end, the arteries and veins of the new gland with those of the organism into which it is introduced, in order to permit the required current of blood to pass freely. This unfortunately, is practically unfeasible. The arteries and veins of these glands are so fine that it is impossible to make such a junction without, at the same time, obstructing their lumen. Now, as no organ can live unless it is fed with blood, we should then have to renounce grafting, tempting and full of immense hopes as it is, or else find some means to compel Nature herself to create *new* vessels designed to nourish the borrowed gland.

At this point, I made the following reflections, which enabled me to arrive at the proper solution. At birth, the living being finds itself provided with all the vessels, arteries and veins which are necessary to it. So long as the organs remain sound, the number of these vessels remains invariable. But, if one of them becomes congested, and this congestion brings on a violent afflux of blood, we observe the formation of multiple small vessels *newly created* in order to leave a passage for the excess of blood. Autopsies on men and animals that have died in consequence of such congestions furnish frequent instances of this fact.

This was for me the ray of light which illuminated the road I must follow in order to furnish the grafted gland with new vessels specially designed to feed it. The surest means of compelling nature to create the necessary new capillaries was to congest artificially, but to an inoffensive degree, the region where the gland should be grafted.

To do this there was no need to have recourse to the microbes which, in certain diseases, cause the congestion of our organs. It was sufficient slightly to traumatize the tissues, to irritate them by scratching, by trifling scarifications made with a strictly aseptic instrument, in order to obtain the desired result — a congestion capable of bringing about the formation of new vessels which would penetrate the transplanted gland and assure its blood supply.

It was necessary, in short, to till the ground before sowing the seed.

This very simple process proved extremely efficacious. I have been able to assure myself of this several times by examining grafted glands removed several years after grafting not only from animals but also from men. For example, on October 6, 1926, a Spanish colleague, on whom I had practised grafting three and a half years before, allowed me to remove the transplanted gland and investigate its condition. He was regrafted during the same operation, in order that his self-sacrificing act in the interest of science should not result in his losing the benefit the grafting had procured.

The remaining grafts that were removed were handed to Professor Retterer, of the Paris Medical Faculty, who, on December 18, 1926, communicated to the Biological Society the result of the microscopical examination of them. The grafts were found to be still sufficiently furnished with cells to assure the perfect functioning of the transplanted gland for at least several additional months. Convincing evidence was thus afforded of the value of the method which allows a gland to fulfil, in another body, during some years, the functions of the original gland.*

I was all the more pleased at being able to furnish this incontestable demonstration of the survival of a monkey gland that had been implanted according to my method, owing to the fact that it had been difficult to convince medical men by mere common sense arguments. It was useless to present to them old men who had recovered their memory which had been very imperfect before grafting, regained facility of intellectual work, developed stronger muscles, assumed an aspect clearly more youthful, and who claimed to have recovered certain powers that had waned with age; the invariable remark was: "All that proves nothing!"

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* *Translator's Note.* — The same opportunity presented itself quite recently, at the time of the last French Surgical Congress, in the case of a man first grafted four years ago. The findings were similar.

"But how, then," was our reply, "are we to demonstrate the effect produced by grafting a young gland, if all these factors, as well as the satisfaction felt by the interested person and often also by his wife, are valueless in your eyes?"

"Microscopical examination of the grafted gland," I was told, "will alone prove that it has undoubtedly survived, and consequently demonstrate that it has really been the direct cause of this restoration of the old man's organism."

Eventually, as I have stated, the thing was done and the most incredulous have had to give way before the undeniable proof given.

Time and experience have allowed me further to perfect my method. I realized, for instance, that the new vessels, the formation of which I had succeeded in bringing about, were too fine and delicate to penetrate the entire thickness of a gland. The periphery was well supplied with blood, while the centre received none and, therefore, perished. In order to remedy this, I decided to cut the gland into four parts, each a centimetre thick, and I had the satisfaction of seeing that all these fragments were well nourished and gave evidence of perfect vitality.

I also established the relation that should exist between the number of these fragments and the surface which must provide the new vessels.

If we plant four or five rose seedlings in an earthern pot of a sufficient capacity to permit the prosperous growth of only two rose bushes, all of them will die, as none of them will receive sufficient nourishment. The same applies to human or animal grafting. Experience allows me to determine exactly the number of segments in each case, according to the area of the surface on which they are to be implanted.

I pass over other details of a technical character which I teach to my pupils.* What should be noted is that this surgical method in regard to glandular grafting, as I have worked it out, is now perfectly systematized and assures the survival of the transplanted gland for several years.

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* See "Etude sur la Vieillesse et le Rajeunissement par la Greffe" published by Doin, Paris, 1926.

CHAPTER EIGHT

Utilitarian Application of Grafting to Old Animals

I BEGAN the experimental application of my grafting method in castrated animals. This was the criterion. The living machine lacked an essential part. Could it be replaced by a similar part borrowed from another animal of the same species?

I chose for these experiments goats and rams, these animals being selected for the reason that castration modifies their appearance to such an extent that any change is immediately noticeable. Performed when the animal is quite young, it prevents the formation of the horns. If the operation is deferred until later, the development of the existing horns is arrested and they take the appearance of the slender horns of the females.

It also produces a change in the conformation of the head, which remains narrower than that of normal animals. Their legs lengthen, and fat invades the body. A characteristic modification is also observable in their physical condition. They become placid, lose their bellicose temper and manifest no affectionate sentiment towards the females — which for that matter, show the most perfect indifference to them.

On such animals, which have lost the attributes of sex and become mere amorphous beings, I have grafted interstitial glands removed from younger members of their species. The change resulting from such operations is truly astounding.

The horns start growing again, becoming unusually large; the excess fat disappears, the muscles develop, the bodily vigor becomes evident at the most cursory glance. The animals again become aggressive and bellicose, and again seek the females which, evidently comprehending that they possess masculine attributes, display complacent attitudes.

At the Physiological Station belonging to the College de France, in Paris, one of these regenerated and remasculinized goats can still be seen. I operated upon it when it was six months old, and at once replaced the interstitial glands I had removed with those taken from another young goat. This substitution was carried out in 1917, ten years ago, and the goat in question in no way differs from a normal goat. The substituted glands function exactly as the original ones would have done. The living machine gave evidence that it had been perfectly repaired, and that the new spare part had exactly replaced the old one.

At ten years of age, which marks the beginning of old age in these animals, this goat remains vigorous and a good-looking specimen, with its forehead adorned with imposing horns. In the spring, if it is placed in the presence of a she-goat, it manifests an amourous ardor to which the female shows a ready complaisance, without the slightest suspicion that the masculine attributes of its gallant swain have been borrowed from a comrade.

I have obtained the same results in old animals exhausted through age, depressed and sad, and dragging out a wretched end to their lives. Useless for breeding pur-

An Old Ram, Between Ten and Twelve Years Old, Taken Before the Graft.

poses for years, through their glands having ceased to function, they corresponded to all intents and purposes to castrated animals.

I treated them as such by implanting in them young interstitial glands for the purpose of making good the deficiency of their own glands. Two or three months after the operation the infirmities with which they were afflicted disappeared, such as trembling of the limbs, and paresis of the hind-quarters, These animals, which had formerly been so wretched looking, thin, with downcast heads, moving about with great difficulty and showing in places the loss of their wool or hair, rapidly recovered a prosperous appearance. The fleece of the rams became abundant and thick; they carried their heads proudly, their movements were active and they again became aggressive and bellicose.

In one of the stables attached to my laboratory there is an old goat which, from being an entirely peaceful animal two years before, became so fierce and evil-spirited after the operation that it was unsafe to go near it unless one was prepared to receive a vigorous butt from its horns.

I was able to make some extremely significant experiments on rams. By grafting on them a young interstitial gland I transformed a formerly senile beast into an animal full of youthful vigor and energy, which astonished us all by its exhibitions of exuberance. Every year marked the birth of a new lamb and, which was more remarkable, these lambs were always of the same color as the grafted ram. *Black* rams shut up in a stable with *white* ewes always produced very vigorous *black* lambs. The characteristics of the grafted male, through the latter's newly acquired vigor, were predominating and transmitted to its progeny.

I still have five of these fine black lambs, the last being born four months after the death of its grafted father — which had been grafted when it was twelve years old, and which died in December last, eight years after the grafting, at the unusual age of twenty!

From some of these old rams, which had been so astonishingly rejuvenated, I removed, a year or two after I had operated on them, the young interstitial gland that had been implanted. Within a few months their miraculous youthfulness disappeared. Animals which previously had such a fine appearance and were overflowing with vitality, aged with surprising rapidity, and became gentle, indolent and shy. The infirmities that completely disappeared after the grafting reappeared, and the females of their species had no longer any attraction for them.

To these animals which had, for a second time, fallen into the condition of wretched and aged beasts, we grafted once more — after leaving them in their degraded state sufficiently long for conclusive proof of their real condition — a young interstitial gland. The transformation of the senile animal into a vigorous beast followed as if by enchantment. The living organism, under the effects of the young grafted gland's internal secretion reacted exactly like a chemical substance which we know will give such and such a reaction, according to whether we add or take away a reagent to which it is sensitive.

The Same Ram, Eight Years After the Graft, With its Ewe and the Fifth Lamb Born After the Operation.

The rams on which these experimental operations were made were kept under observation for some years by a large number of doctors and veterinaries, especially by Professor Gabriel Petit, of the Alfort Veterinary School, just outside Paris, who is a member of the Paris Academy of Medicine.

I have applied the same method to aged bulls, and with the same results. I was unable to make my experiments on bulls at the College de France, because it was not possible to keep there, animals of that size. Fortunately, I found some well-informed cattle-breeders who immediately grasped the possibilites of the use of the grafting method, from the economic and commercial points of view and thus willingly placed some of their herds at my disposal. One of them, Monsieur Georges Nouvion, director of the Algerian Agricultural Company — the brother of my friend Henri Nouvion, one of the Paris directors of the Banque d'Afrique Occidentale — entrusted me with his old bull "Jacky," whose story is worth relating.

French colonial cattle breeders make it a practice of importing some of the best French bulls for the purpose of improving the quality of the native cattle which are much smaller and less vigorous than the French breeds. These imported bulls terminate their career as breeding stock at the age of ten or twelve years and must be replaced, which proves costly to the breeders. How to prolong the period during which these bulls may continue to prove commercially profitable is a very interesting economic problem. It was for this reason that the Algerian cattle-breeding company in question asked me to attempt to experiment with one of their older animals.

Jacky, as the bull referred to was named, was, at that time, seventeen years old, and had become useless for breeding purposes since some two years earlier. I went to Bou Ghellel farm, near Blida, and I saw at once that Jacky was really in a deplorable condition. He was very much wasted in appearance; his hair was dull, his eyes were dim and his head bore every mark of advanced age. Jacky kept away from the rest of the herd and showed complete indifference to his female companions. His place as king of the herd, moreover, had been taken by a young rival from which poor Jacky fled in terror, and with good reason, for the youngster attacked Jacky from the moment the latter came near, in spite of the fact that the deposed rival was animated with the most pacific intentions, and drove him off, the fugitive being incapable of offering the least resistance.

I grafted Jacky on March 5, 1924, with the interstitial gland of a young Algerian bull, two years of age, the operation being carried out in the presence of a very large number of colonists who were interested in the question. My two assistants, Dr. Puelma, and M. Schmidt, a veterinary, who had come with me from Paris, Dr. Barillon, and the veterinarians Pons, Bisselut, Wagner and Barlette, gave me valuable help.

As a matter of fact, to operate on a bull, even when it is aged, is neither easy nor free from danger. In spite of the fact that it had been anesthetized locally and was held by

The Last Three Vigorous Lambs, Born From the Old Ram After He Had Long Passed the Usual Span of Life of His Kind.

ten or twelve Arabs, Jacky showed marked signs of impatience and all of the operators were several times knocked headlong. The experiment, nevertheless, was eventually brought to a successful conclusion.

On June 27th following I received a letter from M. Georges Nouvion, informing me that the operation had been completely successful. The following is a characteristic passage from this letter:

"The bull on which you operated is doing splendidly. Its hair is glossy, its eyes are bright and, most interesting of all, it is full of vigor. A few days ago it served a cow four times in the forenoon — something rather unusual. It has since then continued its duties. I will let you know later if the cows are in calf."

On March 20, 1925, I received a further letter from M. Nouvion, which I reproduce textually:

"I told you in a previous letter of the exploits of the bull Jacky, which you grafted last year at about this time.

At the date on which you performed the operation, Jacky's career as a sire had ceased, and I was on the point of sending him to the butcher.

About three months after the operation, in May, 1924, he resumed his functions on the breeding farm, and he has continued them ever since, the only interruptions being due to the lack of subjects.

Now, among the cows which have been sent to him since he recommenced his work, three have recently calved. Two of the calves have all the characteristics of Jacky's race, and there is no doubt as to the origin of the third.

Further, in order to give you precise details as to the manner in which he has been behaving, I send you herewith extracts from the books kept at the farm since January last:

'The cow Grisette was in relations with Jacky four times on January 19th and three times on February 9th.'

'The cow Negresse once on January 20th, once on February 4th and twice on February 5th.'

'The cow Mandarine once on January 20th.'

'The cow Bichette three times on January 24th.'

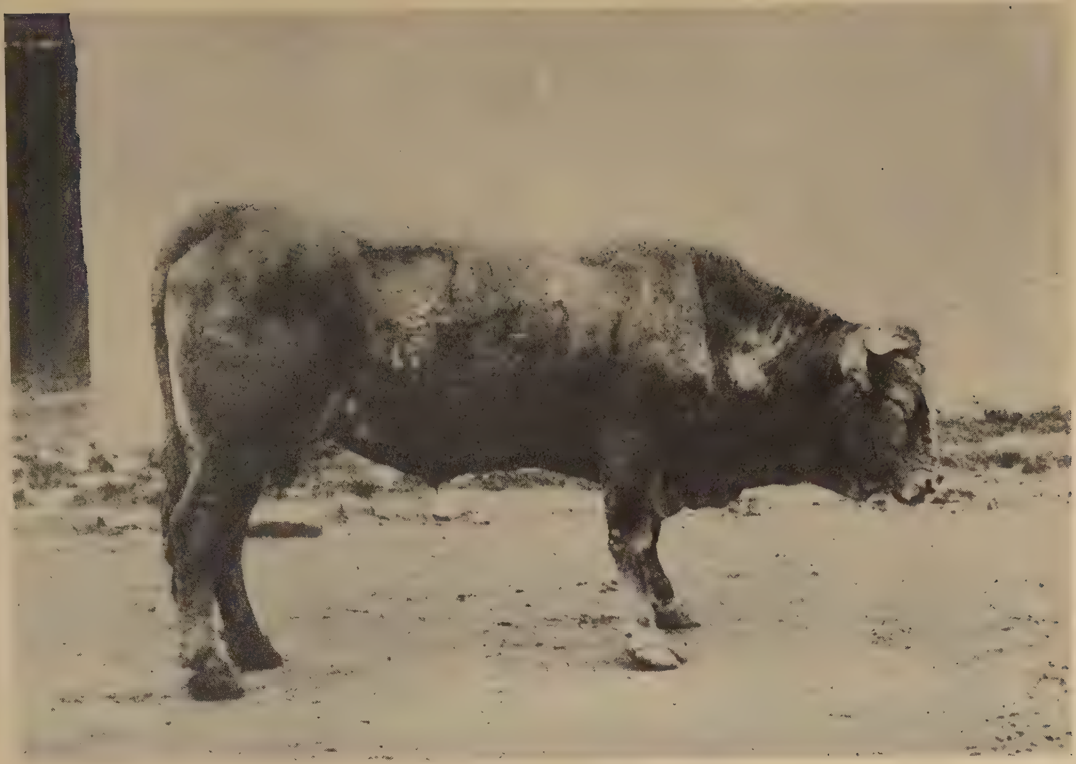
'The cow Zohra three times on January 26th.'

Jacky continues in perfect condition. Its coat is glossy, its eyes are bright. It is further, very vigorous and to such a degree that, when it is shut in, it jumps very high fencing in order to rejoin the herd.

Here is another remarkable fact. On the same Bou Ghellel farm we have another very fine eight-year-old Gascony bull, called Salem. Formerly, when Jacky was decrepit, he was rather ill used by Salem. Today the rôles are reversed: it is Jacky that lords it over Salem, and which is the king of the herd. Everybody on the farm is astounded at the change, and particularly the two native shepherds who are among our oldest employees, to say nothing of myself."

Therefore this aged bull behaved, after grafting, exactly as my old rams do. I saw him again myself on the following April 8th when I was accompanied by Generals Boichut and Gratier, M. Alliez, Prefect of Aliez, Prefect of Algiers, M. Troutette, the Director of the Government breeding department and numerous veterinaries and colonists. I found Jacky radically transformed.

Jacky had recovered his lustre, the muscles had reassumed their fullness, his movements had refound their



The Old Bull "Jacky" at the Age of Seventeen, Taken Before the Graft.

activity. His disposition too, had been modified. Instead of being a poor timid beast running away from its adversary, Jacky was again bellicose and quick to attack. Sexual power had naturally followed the recrudescence of all the living forces of the organism. At the end of a year the benefits of the graft were not only maintained intact, but appeared to be increasing with time.

I saw Jacky again in April, 1927, three years after the operation. I found him looking fine, vigorous, with glossy hair and quite vicious. I was perfectly satisfied, therefore, with the persistency of the results achieved. I had the opportunity further, to be witness of a controversy between M. Nouvion and his head shepherd. The latter insisted that Jacky not only remained a first-class bull, instead of the deplorable beast it had been before grafting, but that it was continuing to fulfil its procreative duty. M. Nouvion, on the contrary, claimed that while Jacky would retain his fine appearance he could no longer be successful as a breeding animal. I confess that I was rather inclined to place confidence in the opinion of the Arab shepherd, who lived with the herd and was able to observe the cattle daily. But, in the colonies, it is necessary inasmuch as possible, to side with one's compatriots, so as to further assert their ascendency. I acted, then, rather from considerations of diplomacy than from real conviction, by declaring that a new graft could in any case, only be for Jacky's greater benefit in further increasing his breeding powers.

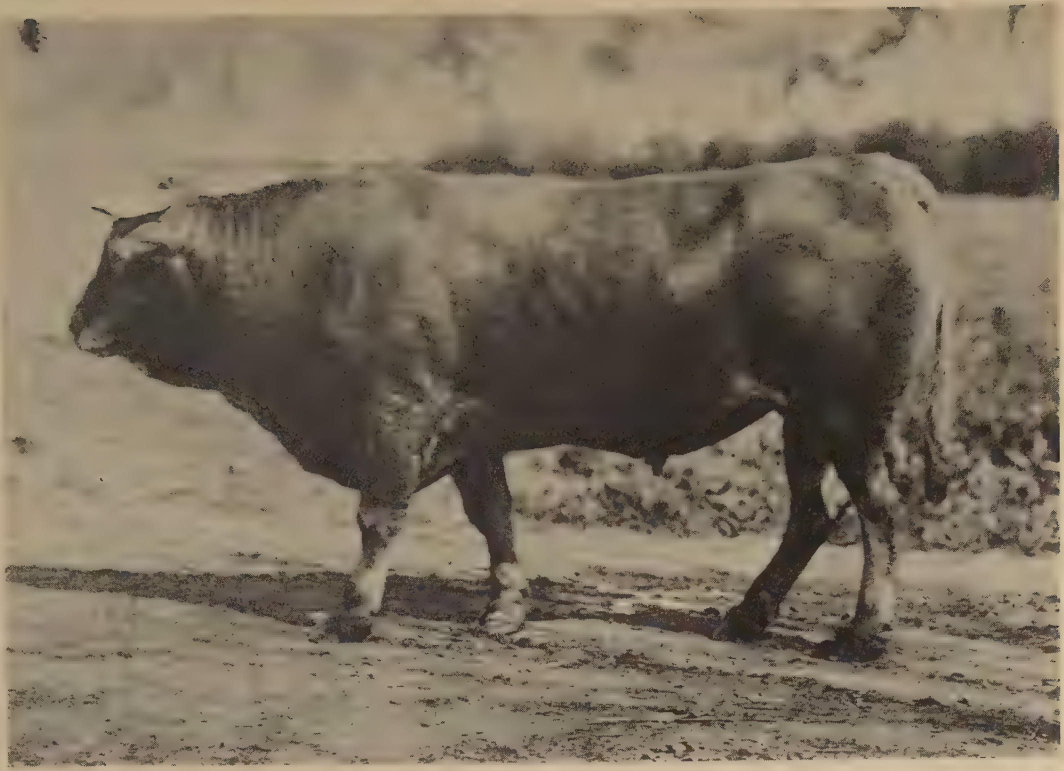
On April 8, 1927, I regrafted him, with the assistance of Drs. Didry and Petinary, two of my laboratory staff, who were travelling with me. Since then I have had excellent accounts of Jacky, and M. Nouvion and his Arab shepherd are now in perfect agreement as to their bull's special capacities.

I have also grafted old horses. Two cases may occur. It may be advantageous to prolong the sexual activity of very valuable stallions, each of whose engagements represents a fee which may be anything up to 25,000 francs, and which may result in the production of a whole progeny of fine horses.

It may be also of interest, in certain cases, to renew the strength and the energy of a horse that has been weakened by age and excessive work. I have operated in cases of both kinds with results so positive that the Italian government, advised by savants belonging to that country, has applied my method of grafting to stallions attached to their army remount department with such a degree of success that the step cannot but encourage other States to adopt a similar policy.

However, there is one danger which should be mentioned. Horses of a too advanced age have brittle and porous bones, like men of great age, who are subject to fracture of the thigh, especially at the neck of the femur. This was the case with Aiala, the magnificent stallion belonging to M. Wittouck, the Belgian racing owner.

Aiala, when I operated on him three years ago at the Alfort veterinary school, was twenty-seven years old. I was assisted in the operation by M. Coquot, professor of



“Jacky” at the Age of Twenty, Three Years After the Graft.

surgery, Dr. Dartigues, president of the Paris Society of Surgeons, and my brother, Dr. Georges Voronoff. In the course of the operation done under local anaesthesia, the violent contractions of the horse's legs caused a fracture of the pelvis. The fact was specially mentioned in the record of the autopsy made by M. Gabriel Petit, professor of pathology, at the request of M. Wittouck himself, who desired that no doubt should exist in the minds of the numerous other racing owners present as to the real cause of an accident that was entirely independent of the nature of the operation. It will therefore be judicious not to delay the graft operation until a horse has become too old. In any case, care should be taken to double and redouble the precautions taken at the moment the horse is thrown and while his legs are immobilized. Operations should also be avoided on horses that are completely exhausted by old age, like some I have seen in Algeria, giving evidence of the deepest physiological distress. There are, of course, limits to the possible reaction of the animal organism.

Grafting can fortify and revivify animals which have been enfeebled by age, but it must not be expected to wake up the dead.

CHAPTER NINE

Utilitarian Application of Grafting to Young Animals

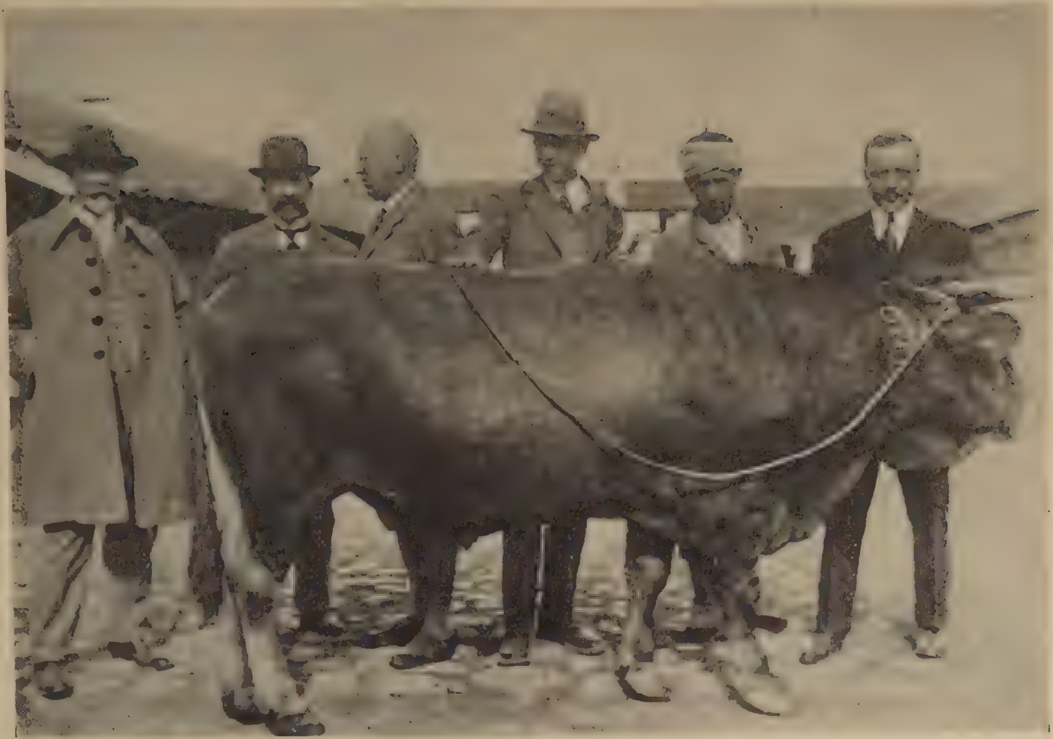
THE observation of aged animals which, thanks to the grafting of a third interstitial gland, recovered greater vigor, stronger muscles and a more abundant growth of hair or wool, suggested to me the idea of applying my method, on the contrary, to quite young animals. Had not the child described by Professor Marro made a bound forward of several years owing to the fact that one of his interstitial glands was, in size, the equivalent of two? If Nature sometimes produces such phenomena accidentally, I reflected, would it not be possible to obtain the same conditions artificially, by means of grafting? Would it not thus be possible to create a race of super-rams, and of super-bulls, by forcing animal nature in the same way as nurserymen have succeeded in forcing vegetable nature to produce, by grafting, finer fruits than the ordinary ones?

Breeders today possess only one single means for improving domestic animals: selection. They eliminate all the deficient specimens and preserve only the finest. This, however, is a very slow method and a purely conservative one. The breed retains its best qualities, but it does not progress. If my theory were correct, I thought grafting must, on the contrary, intensify these best qualities and result in the creation of races of animals that would be far superior to the best that selection could give.

I had especially in view the creation of a race of sheep possessed of a richer, finer and heavier fleece. The internal secretion of the interstitial glands, it is well known, has a direct influence on the growth of the hair. Eunuchs have none at all. The child observed by Marro had too much. Rams have wool that is much longer than that of sheep (emasculated rams). My plan, then, was based on sound foundations, and its realization might have enormous economic consequences.

Every country needs wool, every country consumes more and more of it, but few nations have sufficiently large flocks available to enable them to meet the requirements of their own population. France, for example, although possessing ten million sheep in the Mother country (compared with sixteen millions before the war), nine millions in Algeria, six millions in Morocco, two and a half millions in the Soudan, or about twenty-seven and a half millions in all, is obliged to buy yearly from Great Britain additional supplies costing some 4,000,000,000 francs to meet her needs. Great Britain, with her Dominions, is specially favored in this respect. It is estimated that there are twenty-five million sheep in Great Britain and Ireland, twenty-two millions in India, one hundred ten millions in Australia, three millions in Canada, thirty-one millions in the Unions of South Africa, or a grand total of about one hundred ninety million head.

Next come Russia, which, in 1913, before the war, possessed seventy-three million sheep; the United States of America, with thirty-six millions, Argentine with



"Jacky" at the Age of Twenty-one, Four Years After the Graft, Being Examined by Some of the Official Delegates Sent to Algeria by Foreign Governments.

forty-six millions. The other countries are relatively poor in sheep. Belgium possesses barely two hundred thousand head, according to statistics dating from 1910.

The world's total production of wool, nevertheless, is about twenty-five per cent less than its requirements, which accounts for the high cost of all garments made from wool. With the exception of a few favored countries, all have need of an increase in their output of wool. Unfortunately there is a limit to the quantity of sheep which a country can raise and feed, especially in Europe. The increase in the area of land laid down in food crops necessarily reduces the amount of ground available for use as grazing fields. On the other hand, manufacturing industries have developed to such an extent that they monopolize a large proportion of the population formerly engaged in agriculture and the raising of cattle and other livestock. I have heard it said that in certain of the French provinces the flocks and herds have had to be reduced in number through lack of shepherds. Agricultural workers, at the same time, find more remunerative employment elsewhere.

To this problem — increase of the population, growth of the need for woolen clothing, the general inadequacy of the supply of sheep resulting in the excessive cost of wool — I believe that the widespread adoption of animal grafting might bring an efficacious solution.

Since we can scarcely enlarge the number of sheep, let us devote our efforts to increasing the yield of each one in wool and in mutton.

Grafting saved the French vines, and my learned friend M. Viala, who devoted himself to this vital question for France, largely contributed to its success. Why should not grafting applied to animals, render a similar service? We are at the dawn of a new era. The glandular graft which I have realized should furnish us with a powerful means of forcing the animal organism to give a yield of wool and of food hitherto unknown.

The solution of the problem is the following: It is obviously impossible to undertake the task of grafting all the sheep in each country, which amount to a very large number of millions. The best policy to adopt would be to create, by grafting, a new race endowed with longer and more abundant wool.

In plant grafting we have succeeded in transmitting newly acquired characteristics by using seed produced from grafted vegetables. The new characteristics thus have become hereditary. Last year Professor Julien Daniel, of Rennes, laid before the Academy of Sciences of Paris the most convincing facts in support of this statement.

In 1921, this learned botanist grafted a Jerusalem artichoke on a sunflower which subsequently adorned itself with aerial tubercles. The seeds harvested from this new plant produced in the following year plants bearing at the same time underground and aerial tubercles.

The transmission of characteristics acquired by animals is an equally well-known fact among breeders.

I had all the more hope of being able to stabilize the new characteristics that nothing would prevent grafting being repeated from one generation to the other until their definite fixation. The profit that would result from this procedure was too large to allow the labor of grafting two or even three successive generations to be taken into account.

With this object in view, the question was to graft, not old animals but, on the contrary, quite young ones. My intention was to take animals between five and six months old, in which the immature glands have not yet begun to secrete the particular liquid which makes its appearance in animals and in man only at the period which we term the age of puberty. I proposed to graft on to these youthful animals, not a genital gland equally young and as yet deprived of the internal secretion, but one rich in this secretion, taken from an adult animal.

By this method the youthful organism would be endowed with a powerful stimulant that would hasten its development, mature it more rapidly, and render it richer in flesh and in wool. When its own interstitial glands came to maturity later on, their action would be added to that of the gland that had been grafted and maintain and still further increase the gain already entirely acquired.

The few experiments I first made in my laboratory on sheep obligingly furnished to me by General Champvallier, confirmed my anticipations. The weight of these animals, which had been endowed with a third gland, exceeded that of normal animals when they reached adult age, and their wool became longer and more abundant. I am keeping them in my laboratory, where the facts may be observed.

Encouraged by these results, I decided to make experiments on whole flocks of sheep.

In order to safeguard myself against all criticism and to ensure that the results obtained might be verified by an official and competent authority, I went, in 1924, to Algeria where I knew that the Government possessed a flock of three thousand head of sheep which are under the control of the head of the Algerian Government breeding department, M. Trouette, one of the professors at the School of Agriculture, a savant of high moral and intellectual value who, for the past thirty years, has been untiring in his activity for the public weal.

I explained my project to M. Steeg, the Governor-General and I was given *carte blanche* for my experiments. As I wished to give my method an industrial application, I entrusted these graftings to the veterinaries employed in the Algerian Government's sanitary service, and particularly to M. Bosselut and Castelet, whom I instructed in all the details of my technic, and who carried out the operations under the supervision of M. Trouette.

Two years later, the breeding department of the Algerian Government made known the results that had been obtained. These I reported to the Congress of the French Association for the Advancement of Sciences that took place at Lyons last year.

The experiments revealed that the average weight of the rams that had been grafted at the age of ten months was equivalent, when they reached the age of two years, to 68½ kilogrammes (just over 150½ pounds), whereas the non-grafted rams, also two-year-olds, did not average more than 61.300 kilogrammes (not quite 134 pounds). The grafted animals were therefore heavier by 7.2 kilogrammes (over 15¾ pounds) than those which had not undergone treatment; in other words, by about one-eighth.

So far as the yield of wool was concerned, the average weight of the grafted rams' fleece was 3¾ kilogrammes (8¼ pounds), while that from the non-grafted animals averaged 3.1 kilogrammes (between 6¾ and 7 pounds), the grafted subjects yielding, therefore, 650 grammes (nearly 1½ pounds), on the average, more than the others, or a difference of one-fifth more.

These results, which were obtained by veterinaries operating on a very large number of lambs taken at random in a flock, proved the constancy of the results and the practical value of my method. The sequel to the report that was transmitted by the breeding service to the French Department of Agriculture is much more significant.

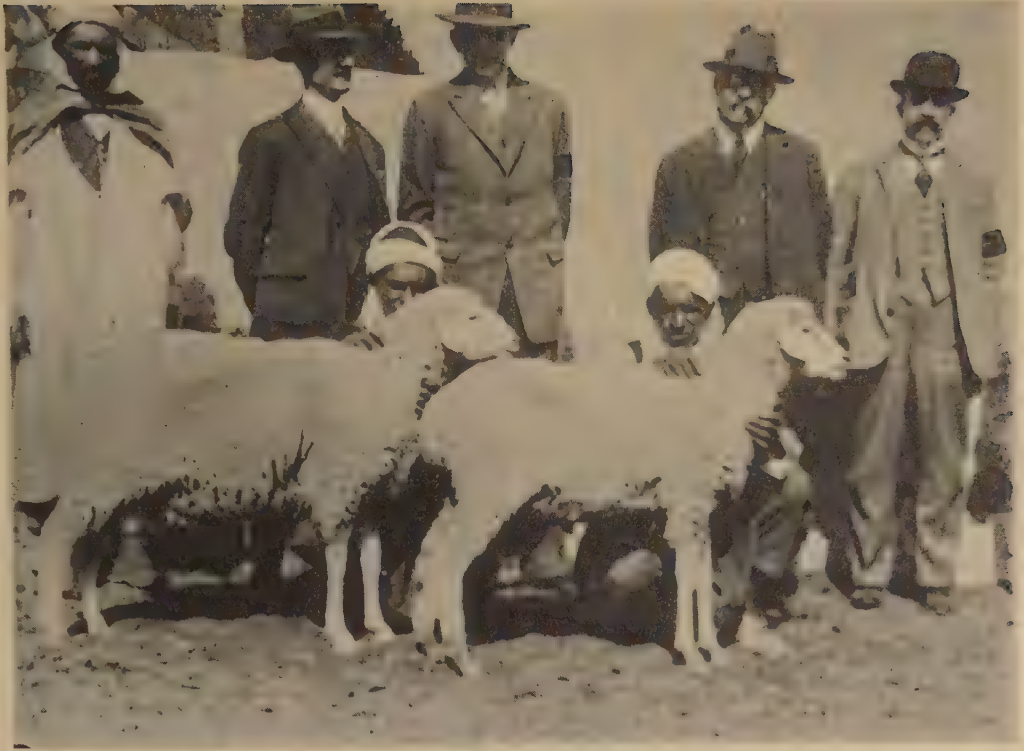
As a matter of fact, when this report was drawn up, the lambs issued from our grafted rams had reached the age of five months. Now these lambs, the progeny of the grafted rams, had an average weight of 38.2 kilogrammes (83 pounds), while lambs of the same age from non-grafted rams weighed only 30.1 kilogrammes (just over 67 pounds), the difference being equivalent to 13 pounds. The average weight of the formers' fleece was 980 grammes (2 pounds, 3 ounces), while that of lambs from non-grafted rams only averaged 680 grammes (a shade over 1½ pounds), a difference of over 10 ounces, on the average, in favor of the former, at the age of only five months.

Thus, then, the intensity of life, the creative energy procured a young animal by the grafting of a third interstitial gland enables it to transmit, from the first generation, a great proportion of his newly-acquired qualities.

I confess that this observation filled me with profound joy. It opened immense prospects. In reality, if the grafted male transmitted its acquired qualities in constant fashion to its own issue, this would offer enormous advantages, even if the transmission of such qualities were limited to the first generation.

Let it be remembered that each ram, on the average, obtains issue from fifty ewes. The grafting of one ram, then, would ensure the production of about fifty lambs endowed with superior qualities. For a flock of a thousand ewes, it would suffice to have twenty grafted rams in order to secure, by the end of a year, about one thousand sheep weighing one-sixth more than normal animals and yielding one-fifth more wool.

As the effects of the graft persist among rams for about three years, these twenty rams would be able to transmit their qualities to three thousand sheep issuing from them. The rate of profit to be gained would be enormous, for the grafting of twenty rams could be accomplished by two veterinaries in a couple of days and would necessitate a negligible expenditure when compared to the benefits. The required grafting material always exists in abundance, inasmuch as, in every flock, all rams destined for the butcher invariably undergo castration.



The Ewe on the Right-hand Side of the Picture is Issue From a Non-grafted Ram. The Other Ewe is Sired by a Grafted Ram.

Standing Behind are: M. PROUST, DR. S. VORONOFF, N. TROUETTE, *and a Representative of the French Ministry of Agriculture.*

Henceforward, instead of throwing away these superfluous glands, they would be utilized as grafts. They would represent no expenditure for the breeders and the accessory expense would be relatively trifling.

I made these reflections on reading the reports of the Algerian Breeding Service dated April, 1926, and I naturally felt a desire to know if my deductions would be confirmed by facts. I let another year go by, and on April 20th of last year I returned to Algeria, accompanied by my two assistants, Drs. Didry and Petinari.

From Algiers we went to Tadmit, the Algerian Government's breeding farm. There M. Trouette and Major Cottanceau, the director of the station, passed in review before us the eleven flocks, two of which were composed entirely of ewes and rams of between twelve and eighteen months, the descendants of the rams grafted in October, 1924 and April, 1925.

The latter were very plainly distinguishable from the ordinary flocks by the abundance of their wool. Some of them, indeed, presented a half-monstrous appearance owing to the excess of wool covering their whole bodies.

When the eleven flocks were shorn and the wool from each animal was weighed, it was invariably found that the sheep forming the issue from the grafted rams gave — on an average — one-sixth more wool than those issued from non-grafted animals, and that the weight of these animals was one-fifth greater. Invariably also, the young ewes issued from a grafted sire gave one-sixth more wool than their dams. So the result is constant and general, as confirmed by several animals.

The wealth of each country in wool may therefore be enormously increased by the aid of grafted rams, which would ensure at least one generation of sheep that would be superior in both wool and weight. I foresee, then, in the near future, the organization in every country of stud farms for rams which have undergone grafting and which are destined to mate with ewes for breeding purposes. When the British Government became acquainted with the foregoing facts, it recognized immediately the immense interest my method of grafting might prove once it were introduced into England and the Dominions. The British Minister of Agriculture, with the authorization of the French Government, sent a special official mission to Algeria on November 4th of last year. The Spanish, Italian and Argentinian Governments have done the same, and their reports, which will confirm on all points that of the Algerian Government's Breeding Service, will be published shortly.

I have attempted similar grafts on pigs, on the farm of a very practical breeder, M. Durand, of Baron, in the Department of Oise, who requested my help to ascertain if it would be possible by grafting, to diminish the quantity of fat and, at the same time, to increase the amount of flesh in these animals, with a view to improve their commercial value.

Experiments proved that after an interval of ten months, the young porker, to which had been implanted a third interstitial gland, had gained 7½ kilogrammes in weight (over 16½ pounds) over its non-grafted brethren *of*

An Ewe Sired by a Grafted Ram, Showing Heavy Fleece.

the same litter, and appeared to have firmer flesh, while the body was not invaded by fat. Brought up together on the same food and under absolutely identical conditions, the porker grafted on October 3, 1923, weighed 123 kilogrammes on April 28, 1924, and its non-grafted comrade 115½ kilogrammes. This should not be surprising. The abundance of the internal secretion produced by the three interstitial glands must naturally stimulate and accelerate the growth of the animal and the development of its muscular framework.

Grafting may also find other useful applications. The greater proportion of the French African colonies have no horses and the native oxen are not strong enough to do useful work. The consequence is that, in these colonies, man is the normal beast of burden, and tens of thousands of natives are diverted from agriculture to act as bearers, and carry out the overwhelming and exhausting work of transporting heavy loads upon their heads, a form of labor which the Government is seeking to suppress.

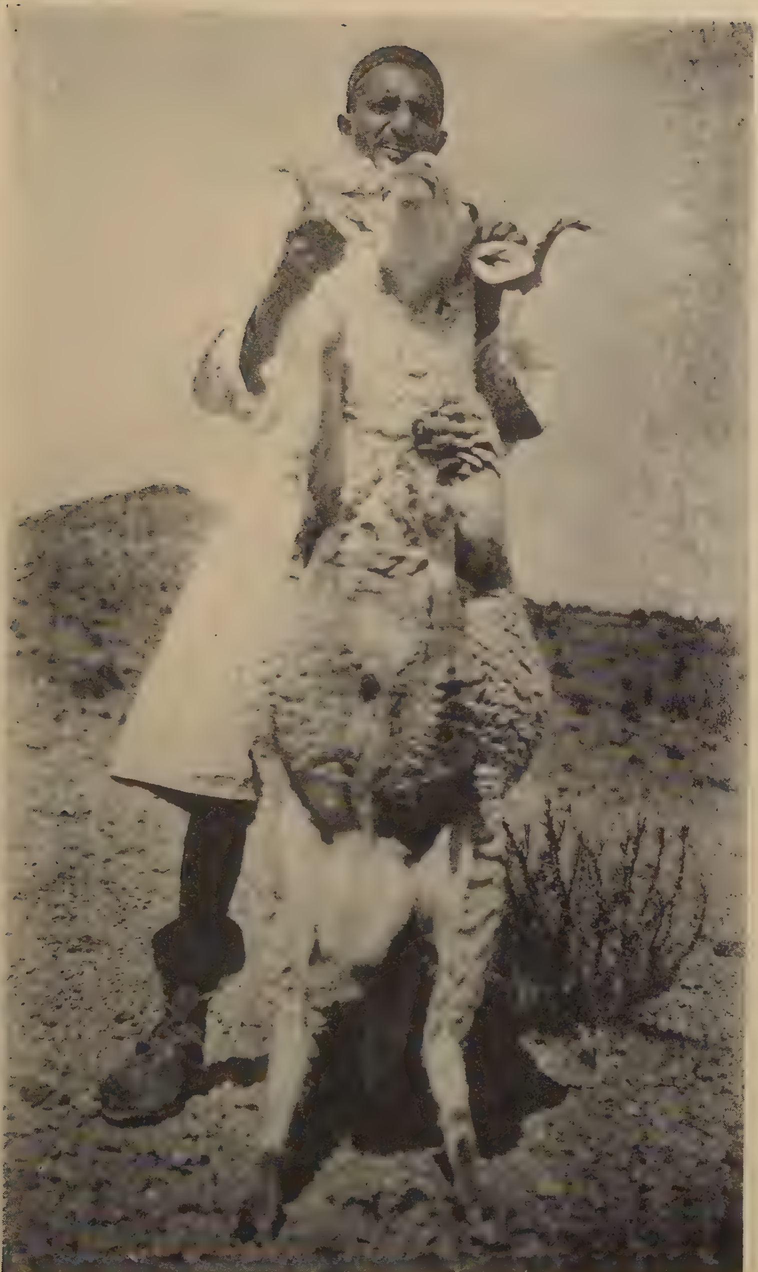
On the other hand, it would be of great advantage to introduce into the colonies the plough, an instrument which is still unknown to the natives. In order to do so, however, it will be necessary to supply draught animals, which are almost entirely lacking. Attempts to acclimatize animals brought from other continents have not proved successful. They die from anaemia or from liver trouble, and are, above all, decimated by the tsetse fly.

Now, it is impossible to ensure the prosperity of colonies without cattle. In the absence of these auxiliaries, indispensable to man, especially in agricultural countries, where industry produces almost nothing, we are faced with an unsolvable problem. The whole future of the colonies depends on this question of cattle which is all the more serious because, through the lack of animal flesh, the natives never get food that contains the requisite amount of sustenance.

Always insufficiently nourished, they remain feeble, offer little resistance to the diseases that are so numerous in those countries, and their mortality is unusually high. Sleeping sickness, which very rarely attacks Europeans, makes ravages among the natives precisely because of their feebleness and their physiological destitution. The mothers have poor and insufficient milk, and the mortality among children is frightful. Colonial populations do not increase, the primary reason being the lack of nourishment. Cannibalism, which has raged throughout the whole of Africa, was directly engendered by the absence of cattle. Men were eaten because there was no animal food to be had.

From every point of view the question of cattle is of the first importance in the colonies, and their future depends on its solution. To fortify the native oxen, increase their size, augment their energy, their muscular strength, their power of reproduction, would be an immense benefit for all these colonies.

Can grafting do this? I hope so. The realization of animal grafting, of glandular grafting, opens up new horizons and possibilities hitherto unsuspected. Grafting of the



Another Ewe Sired by a Grafted Ram and Showing a Very Heavy Fleece.

pituitary gland, which influences the growth of the bones by supplying young animals with a surplus of this gland's internal secretion, might help that of the thyroid, carried out at the same time, would increase the strength, the energy, the endurance of these animals, their power of procreation, the duration of their useful service to men. The material for grafting is always easy to secure from animals that are slaughtered for food. Later on, after a few generations, it may be hoped that we shall see definitely acquired the qualities that have been artifically developed.

The breeding of sheep and goats is another very hard problem in the French African colonies. The sheep found there are of small size and have little or no wool, its place being taken by hair. Rams imported from the Cape or Australia rapidly lose their sexual power; hence the great difficulty of crossing them with native subjects, in order to improve the latters' degenerated race.

Preoccupied by all the vital problems related to the prosperity of the French colonies, M. Daladier, Minister for Colonies, and M. Carde, Governor-General of French Western Africa, requested me, in 1924, to go out to the West Coast and ascertain whether glandular grafting could not be utilized to bring about some improvement in the native supply of livestock. I went there in 1925, in company with my friend Louis Proust, a member of the Chamber of Deputies.

At Dakar we found M. Carde who went with us across Senegal and the Soudan, as far as Timbuktu.

At the frontier of French Guinea M. Poiret, the Governor of the colony, was awaiting us and accompanied us to Konakry.

All along the route the natives, obeying orders they had received, brought their flocks to us; I thus had an opportunity to observe them and additional information was given me by M. Curason, the head of the colonial cattle-breeding department, who accompanied us.

At the end of the journey it was decided that the first efforts should be directed towards improving, by the application of my method, the stock of sheep. I therefore instructed the veterinaries in my method of operating, and grafting stations were organized in various districts, notably at El Oualadji, the breeding centre near Timbuktu. I have every reason to believe that good work has been done there, in spite of the very limited number of veterinaries in those countries.

The report addressed on April 24, 1926 (No. 4, 970), by M. Terrasson de Fougeres, Governor of the French Soudan, to M. Carde, the Governor-General of French West Africa, contains the following paragraph:

"Apart from its action on the growth of wool and the rapidity of the animals' growth, there is one consequence of the graft that we can forthwith expect, leaving aside the consideration of other results: that is the prolongation of the duration of sexual activity in imported breeding animals. The procreative power of these valuable animals, which are imported at great expense, diminishes more quickly than in their countries of origin. Now, it has been

A Flock of Sheep Issued from Grafted Rams.

found possible by grafting an Angora goat, to make reactive its breeding functions which had been lost for over a year, and it is the father of cross-breds born recently at El Oualadji. From the economic point of view this is a very interesting result: reducing the purchase price of foreign breeding stock by prolonging the reproductive life of our rams."

CHAPTER TEN

A Stock of Spare Parts for the Human Machine

BY 1919 I had already performed 120 experiments on animal grafting, and had put the finishing touches to my method in all the details. As a matter of fact I had been experimenting with a view to the possible application of the glandular graft to man. As Director of the laboratory of experimental surgery at the College de France, my task was to make researches in the domain of surgery, in order to discover new methods that might be useful to humanity. The College de France and the Faculty of Medicines stand for two quite different aims.

The Faculty of Medicine's duty is to keep up the scientific knowledge already well established and to teach it, through its professors, to its students. It is a conservative institution which has the custody of the scientific patrimony left by past generations.

The College de France, on the contrary, is a progressive institution, which works for the future. The mission of those who have the honor of belonging to its staff is to work for the advancement of science. They are not professors: they are investigators; and in the domain of medicine our researches are made on behalf of man.

Before new methods can be applied to man, however, it is necessary to experiment with animals. Anti-vivisectionists lament over the fate of our laboratory animals, and I am heartily with them. But, should we experiment on human beings, in order to discover methods which may serve to save our lives, ward off infirmities, cure us of serious diseases?

Without these preliminary experiments no progress in medicine is possible. We must make our choice, therefore: either man or animals.

I chose the animal, not merely from my conviction that human life is decidedly worth more than that of a rabbit or a dog, but also because having once been very painfully impressed when I was a medical student.

I had, among my professors, a celebrated surgeon who died a few years ago, and to whom, very justly, a statue was erected in Paris. He was a marvellous operator, and a pioneer in surgery. He discovered, among other methods, the one which permits enormous abdominal tumors to be removed from women without opening into the abdominal cavity and by withdrawing them through natural passages, as though it were a case of child-birth. This, at a time when abdominal surgery still presented serious dangers, was truly an ingenious technic and much less risky than the old way of proceeding.

On one occasion, this famous master was giving us a clinical lecture, in the hospital ward, on his new method of operating. He was pleased and proud to tell us of the large number of women whose lives had been saved by his technical method. But he added: "I will say nothing regarding my twenty-two first patients, who all died; but you see the present results, the number of women I am saving . . ."

Delegates from the English, Italian, Spanish, Czechoslovakian, Argentine and French Governments, Who on November 4, 1927, Witnessed the Remarkable Results Obtained by Grafting According to Dr. Voronoff's Method.

I admired my master, his coolness, his consciousness of having accomplished his duty on the field of battle launched for the purpose of saving his fellow creatures; but I felt profoundly moved at the thought of those twenty-two unhappy women whose lives had been sacrificed in order that others might be saved afterwards.

In spite of my veneration for my teacher, I could never help thinking that he had been wrong in first practising on human beings the new method he had conceived, instead of testing it, first of all, upon animals.

Are anti-vivisectionists of my opinion, or do they believe my old master was right, and are they prepared to sacrifice human beings for the good of their own health?

In the course of my own researches I have not even had to sacrifice beasts. In order to restore vigor to aged animals, I have only to emasculate younger ones, an operation which, in our laboratories, is practised under anaesthesia, while it is still performed, in all countries, under barbarous and atrocious conditions, on millions of animals — horses, bulls and rams — without our anti-vivisectionists saying one word against it.

When my preliminary work was finished, however, and I proposed to give men the benefits of a method I had tried on animals, I found myself in an embarrassing situation. In this new surgery it was no longer a question of depriving an individual of a diseased organ, but of endowing him, on the contrary, with a sound one. Where could the latter be found?

Bone and skin grafting was practised on human patients prior to my glandular grafts on animals and demonstrated that the operation succeeded only between individuals of the same species. It would be necessary, therefore, in order to graft a gland on an aged man, to procure the new gland from a young man. But it would obviously be a rather questionable proceeding to propose depriving the latter, at the outset of his life, of a source of energy on behalf of someone else who had exhausted his own, after having enjoyed the benefit of it for many years. The law, moreover, forbids such a thing — at least in France. In such cases the consent of the giver would be valueless in the eyes of the law which stipulates that "no person has the right to dispose of his body." It belongs to the State. As a matter of fact an emasculated man, even if only one of his interstitial glands has been removed, is unfit for military service. Moreover, even if the law did not stand in the way, generous donors, in a matter of this special kind, would be very seldom found.

The few offers which I have actually received demonstrate that men, as a rule, place on their interstitial glands extraordinary high prices which only multimillionaires could afford to pay. In this they are certainly right, and my only reproach against them is that they should wish to regard such a matter as a source of profit. On the other hand, I esteem highly the young engineer who offered to give me one of his glands in order that it should be grafted on his old father, who was greatly enfeebled by age. In my remembrance I place this devoted son on the same pedestal as the young schoolmistress who wrote to me in terms of sublime self-sacrifice, begging me to remove her eyes for the purpose of grafting them in a blinded man of the Great War.

One source of available human spare parts, nevertheless, may become accessible, without injury to anyone, when doctors shall be authorized to remove them from the bodies of healthy men who have died from accident. Contrary to the ordinary belief death is never an instantaneous event. The stopping of the heart beats and the arrest of breathing indicate only the beginning of death, which gradually and slowly spreads to the other organs; all of them are condemned to die for the lack of supply of the nourishing liquid, the red blood necessary to maintain life; but they can remain fasting, so to speak, and continue to live for a certain time.

When the guillotine cuts off the head of a criminal, this head, severed from the trunk, remains alive for some minutes; the brain does not deteriorate instantly; and this head thinks . . .

I believe that the horror which the condemned man experiences during those moments is much more frightful than that which he had in approaching the guillotine.

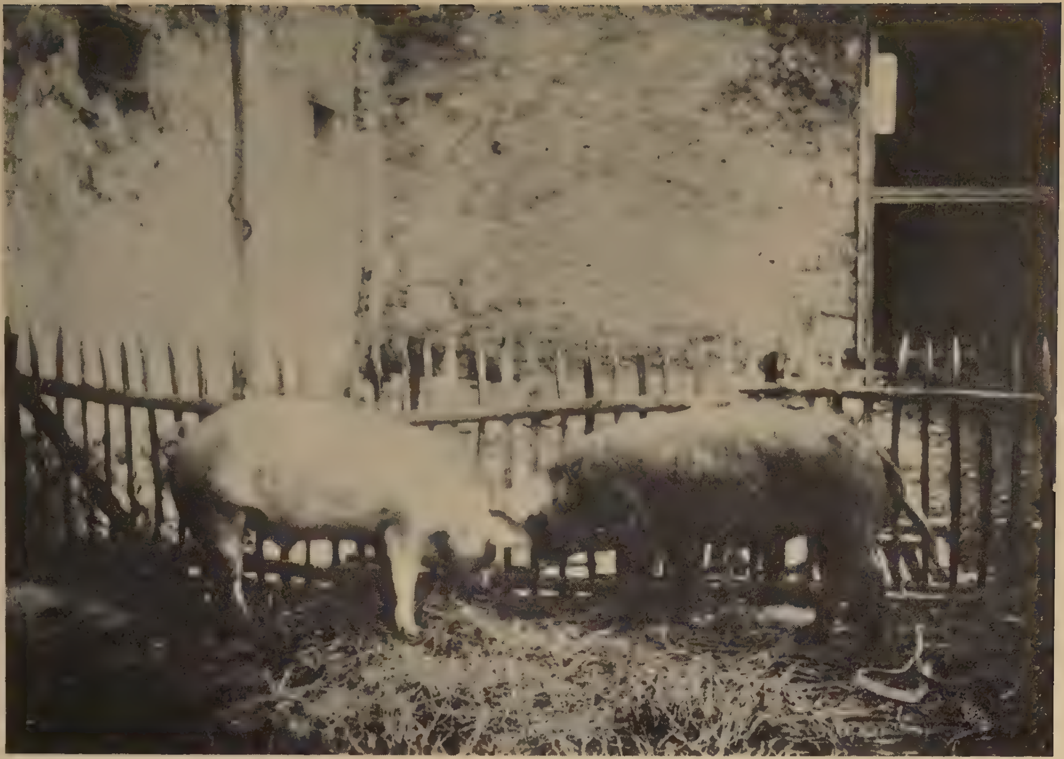
The other organs of a man killed by decapitation, or merely the result of an accident, survive still longer. Each organ continues to live for a shorter or longer time according to the delicateness of its composition. The bones survive for eighteen hours; the kidneys, the liver and the glands for from six to eight hours. If they are removed in time, these organs retain all their vital properties and, if transplanted in another body they are capable of again accomplishing their former functions. The difficulty is to ensure their removal within the lapse of time during which they continue to live in the dead body of their original possessor.

Special hospitals should be created in the large towns, where fatal accidents are so numerous and so varied, in which people, to whom the grafting of a new gland or of an organ could ensure the restoration of strength or the re-establishment of a function, might be assembled. Any man who had died by accidental means, would also be immediately transported to this hospital, where his organs, after careful examination, would be removed for grafting purposes.

Unfortunately, prejudice and the law, which has not progressed to the same extent as science, are still opposed to such a proposal. Time-honored customs demand that mortal remains be given back to mother earth, where they slowly and uselessly fall into decay. But time will achieve its work. The evolution of minds and of the law will follow the evolution of science. Blind sentimentalism will give way to the lofty consciousness of a higher duty: to serve humanity, even after death.

Besides, would not reviving, even though it be a small parcel of one's self, becoming again an integral part of a living, active, thinking being be a more enviable fate than the uninspiring destruction at the bottom of a grave?

While awaiting that time, of which I do not despair of seeing the advent, we cannot count on the treasures of



Two Young Pigs From the Same Litter, at the Age of Ten Months. The One on the Right of the Picture Was Grafted When It Was Six Weeks Old; the Other Was Not.

life which the dead hold for us. It may possibly be easier to be permitted to remove the organs, after the execution, from the persons who have been condemned to death. All those to whom I have expressed a proposition of this kind, however, have manifested the deepest repugnance at the idea of incorporating into their own bodies an organ taken from an executed criminal.

In any case, even if all these difficulties were eliminated, the grafting material furnished by victims of accidents would be very limited. Too many conditions would have to be brought into unison for the success of the undertaking. A gland would have to be removed and grafted within six hours after the death of its host. The preservation of glands in cold storage, or in a physiological serum, allows their use for the manufacture of extracts and powders for opotherapic purposes, but for grafting, which necessitates that the cells be really living, long preservation in this way would be merely a contingent method.

M. Prat, surgeon to the Hospital St. Roch, at Nice, who followed my work in Paris, has had the opportunity to make use of glands from young men who had died by accidental means. In one case he had the good fortune to be able to carry out the grafting operation within the normal limit of time, and he obtained excellent success. In the other case he was obliged to preserve the gland in physiological serum and was unable to make the graft until twenty-four hours after the gland had been removed from the corpse: the result was negative.

If the human graft could be carried out only with human glands, it would be impossible except on very rare occasions, and would then constitute rather a curiosity than a practical matter. Fortunately, in 1913, I discovered a stock of spare parts for the human machine in the bodies of the higher species of monkeys. At that time nobody could be induced to believe this. It was in vain for me to insist on the near relationship that exists between the human kind and monkeys, and on the fact that grafting between animals of widely differing species, which would always be doomed to failure, must not be confounded with grafting between animals of closely related species, such as the horse and the ass, the rabbit and the hare, the man and the ape.

In the medicine that sometimes lies in the great treatises — indispensable, nevertheless — in which professors repeat over thousands of pages what has been written by their predecessors, without being able, usually, to verify all that which they bring forward at second hand. These professors, bearing the load of several centuries of recorded doctrine, have often no other criterion than the official standing of preceding authors to justify them in placing faith in that which they set forth. The assertions of a chief of clinic of a hospital have to be taken into consideration; the affirmations of a learned professor must be cited; the work and the experimental results obtained by a professor are put forward as sacred dogmas which must not be questioned. If, by misfortune — and misfortunes are frequent in human nature — the illustrious professor quoted has committed errors, these are handed down from one generation to another in all the standard treatises. Students learn them in the medical schools, carry them with their medical diploma and find the greatest difficulty in getting away from them.

It so happened that misfortune had willed that two or three professors, whose names are authority, had failed, not in the attempt to graft healthy glands, which they had never tried, but in the endeavor to implant on monkeys some diseased human tissues. This proved sufficient for the official savants to proclaim that grafting of this kind was absolutely impossible.

It mattered little to them under what conditions these graftings had been carried out; whether the monkeys which had been selected were of an age suitable to make them fit subjects for the implantation of certain diseased tissues, whether experiments had been made on a sufficiently large number of animals. Nothing was taken into consideration except the reputation of the professors to whom infallibility was attributed — an infallibility which they, themselves, as true savants, in no way claimed to possess. Thus all scientific progress is achieved at the cost of a long struggle against time-honored errors.

It was as far back as 1840 that Claude Bernard discovered that the liver elaborates sugar at the same time as it produces bile — a now commonplace notion that is learned by medical students. Nevertheless, in 1878, thirty-eight years after his discovery, Claude Bernard had still to accumulate proofs and new experiments in order to combat the systematic denial of his discovery by savants whose theories were hostile to the fact that the same cell in the liver could manufacture at the same time two products so dissimilar as sweet sugar and bitter bile.

Pasteur, for twenty years, had the whole Medical Faculty, with the famous Professor Peter, the obstinate defender of perpetuated errors as its leader, drawn up in battle array against him. For twenty years this hatred of Pasteur was such that any candidate for admission as professor was pitilessly rejected if he had the audacity to cite that great genius's name. He was not forgiven for combatting the opinion then ruling at the Medical School, which refused to admit the existence of invisible microbes, an invention which they stigmatized as absurd.

Truth, however, always prevails in the end. The detractors of Galileo were unable to stop the rotation of the earth and, in due time, they had to agree that it revolved. My opponents, the number of whom happily diminishes from day to day, have not been able to prevent over a thousand persons, in the course of seven years, recovering, thanks to glands removed from monkeys, the vital energy that had been abolished by age. I have even had the supreme moral satisfaction of performing this operation, looked upon as opprobrious only a few years ago, on a large number of my colleagues.

My confidence in monkey glands as the proper material for human grafting dates from 1913. I was not then yet a member of the College de France, but I had a laboratory of my own where I carried on researches in complete freedom of mind. It was there that I succeeded in carrying out the experiments that opened to me the doors of the College de France.

After having removed from a ewe its two ovaries, I grafted them on another ewe born at the same time from the same mother; with these borrowed ovaries the first ewe was able to give birth to a lamb. In my laboratory, I had also some monkeys, and studied their anatomical constitution, and the composition of their blood. I then began to realize that there was a close kinship between us and these younger brothers. If Huxley, the celebrated English savant, was able in his masterly work, "Man's Place in Nature," to call man "a monkey of genius," the anthropoid apes — the chimpanzee, the gorilla, the orang-outang and the gibbon — well deserve to be described as primary men.

There is no doubt that we represent the ultimate end of long animal evolution. There are to be found in the human body no fewer than one hundred and thirty atrophied organs — vestiges of organs that we possessed centuries ago, when passing from one stage to another. I have myself had the opportunity to operate on a child, the son of a chief clerk at the French War Office, who had an orifice in the neck communicating with the windpipe, — the remains of the gills of a fish.

Moreover, examination of the human embryo in its first days of development, displays the various phases through which we have passed. It starts from a single cell — the fecundated ovum, — a shapeless primitive being, already endowed with life, like the protozoön, which assumes progressively the condition of fish, reptile, bird, mammal, and then at the age of two or three months, assumes an aspect that might equally well represent the human foetus or that of the chimpanzee. The difference becomes accentuated only later, but even at five months the resemblance is still notable, as one can realize by looking at the drawings made by Buffon of the five months' foetus of the gorilla.

Selenka, who has made the most complete study of apes, considers the chimpanzee as our nearest relative among the various monkeys; and after having passed in review the anatomical constitution of the chimpanzee, he came to the conclusion that the resemblance between the premolars and molars of the final dentition of the chimpanzee and human teeth indicates that the chimpanzee and man have a common origin and come from beings that are now extinct. It is certain that in the zoölogical chain the higher monkeys immediately precede us.

It is therefore logical to admit that, at a given moment in the history of our globe, a phenomenon occurred analogous to that which we may frequently observe in families. Have we not known of humble parents whose intellectual development was below the average, giving birth to geniuses like Pasteur, Newton, Michelangelo, and also beget mediocre and even weak-minded children? An ancestor of the existing anthropoid apes may have, perhaps, procreated an offspring of genius which, by ascending evolution, became a human being, while its inadequately endowed brethren remained monkeys.

In any case, it is undeniable that, in the whole animal series, the monkeys most closely resemble man. Even the brain of the higher monkeys strangely resembles ours. In fact, in all animals, the cerebellum is situated behind the cerebral hemispheres, which are too small to cover it. In man, on the countrary, the two hemispheres, which are the seat of intelligence, have attained such a degree of development that they overlap the cerebellum: their hemispheres also overlap the cerebellum.

It is equally important to point out that their blood is like ours, and has the same composition, with red globules of the same size; like ours, it differs from the blood of every other animal, even from that of the lower monkeys. It is not astonishing, therefore, that the organs of the monkeys, finding in our bodies the same soil, the same blood, may be grafted therein and continue to live in their new host.

I ascertained this for the first time in 1913, when my researches bore on the possibility of remedying the conditions of children deprived of the thyroid gland. Such children, while possessing a normal brain, remain backward, idiotic, because the cerebral cells require the internal secretion of the thyroid gland in order that thought may come into action. At the same time, these children remain indolent and apathetic, their growth is arrested, the muscles and the skin are invaded by a gelatinous tissue. They are pitiable beings, verging on the animal state, and are a source of grief for their families.

I operated on such a child, Jean B., aged fifteen, on December 5, 1913, at St. Marguerite's Clinic, in the presence of nineteen doctors. I grafted into the boy's neck the thyroid gland of a chimpanzee. My friend, Dr. Montalti, of Nice, and I kept the patient under observation for fourteen months. As this went on, the improvement in the child's condition was gradual and very noticeable. He resumed growing; his face, little by little lost its yellowish earthy color; his nose and lips became less swollen; the facial oval became elongated. The formerly apathetic and drowsy child became more and more active; but his intelligence, above all, increased rapidly, and he was able to go to school.

I reported my observation of this child to the Academy of Medicine, on June 30, 1914, and presented photographs taken before and a year after the operation. I then lost sight of my young grafted patient owing to his father, who was of Corsican origin, returning to Bastia at the end of 1914. Not receiving any news from him, in spite of his parents' promises, I feared that his silence was a bad omen. Great was my delight when in 1917, I received a letter from Bastia in which Jean B.'s father begged me to appeal to my influential friends in Paris to get his only son removed from the advanced first line of trenches, which he was then occupying, to a less dangerous post. Thus the boy whom I had known in 1913 as a pitiful imbecile, with the body of an eight-year-old child, had, four years later, been passed by the army doctors as fit for active service and was doing man's duty.

A Young Chimpanzee, at Grimaldi.

The monkey's gland had filled its rôle with wonderful success, and the internal secretion which it supplied had stimulated in the human being not only the growth of bone and the development of the body, but also cerebral activity. It had not atrophied, therefore, nor had it been reabsorbed, but had continued to work as perfectly as if it had been a human gland. I thus obtained experimental proof that the gland of a monkey can replace that of a man.

Another case of a child, whom I grafted in Paris in 1916 with the thyroid gland of a chimpanzee confirmed the previous experience. Since then I have had many occasions to practice thyroid grafting for the purpose of curing cretinism, restoring development in backward children. At the beginning, however, monkeys were lacking. I had not organized the regular shipments which are now made every month. Several times I had to have recourse to the child's mother and remove from her one of the three lobes of which the thryoid gland is composed, which caused her no more harm than the slight trouble of the operation.

I have made use of the gland of the patient's mother to the exclusion of all others, not because it possesses more virtue than the glands of other members of the family, but because it was always the mother, in her sublime devotion, who offered herself to succor the child which had been disinherited by Nature. I have certainly had quite good results, notably in the case of a little idiotic girl referred to me by Dr. Lesne, of the Tenon Hospital, and on whom I operated in the presence of the doctor and of Professor Gabriel Petit, on November 7, 1918. But the results have never been equal to those I have obtained from chimpanzee glands.

Can it be that the ape is physically superior to man by reason of the quality of its organs, its more robust constitution, unstained by inherited morbid affections: arthritism, alcoholism, or syphilis? I believe so. In any case, I can affirm that the grafting of monkeys' thyroid glands has given me much better results than the use of the human gland.

Before going into the grafting of the interstitial gland my observations on thyroid gland grafting had already shown me that a monkey's gland can perfectly well adapt itself to the human organism. If others have not succeeded in carrying out much simpler graftings, it is because they have employed an improper method and the fault does not rest with the monkeys. As I have already explained, glandular grafting on man, which is infinitely more delicate than plant grafting, demands a special and very exact technic which it was necessary to find in order to assure success.

Nowadays, however, all this discussion as to the value of monkey glands for human grafting is no longer anything more than retrospectively interesting. Over a thousand graftings on men and women have amply proved that I was right as early as 1913, but a period of ten years was necessary in order to convince the medical world, or, at least, those doctors who obstinately refuse to see.

My great concern now is to assure the conservation and the multiplication of monkeys. Men have multiplied much faster than monkeys. There are about twelve hundred million men in the world, but the number of monkeys is infinitely smaller. The first step to be taken was to prevent the ruthless extermination of these animals, which formerly prevailed. Hunters, in fact, usually killed the mother in order to secure the little ones. In 1923, at my request, the French Government prohibited the destructive hunting of chimpanzees in our African colonies. Henceforward these animals must be captured only by means of nets or traps; the precious beings are no longer killed.

Hunters have told me, when I made my journey in French Guinea and the Soudan, that the death struggle of a chimpanzee is one of the most painful of spectacles. Its human attitude, its imploring eyes produce a profound impression and one feels as much anguish as if the shot had brought down a human being.

I have also pleaded their cause, which is at the same time our own, before the King of Belgium and the King of Spain, and, latterly, before the British Government. Everywhere measures to preserve these animals are to be taken.

But it is not enough to protect the existing monkeys. Some means must be found to increase their numbers. Now, animals can multiply only when they are kept in captivity.* In a savage state, many of them are killed by the stronger wild beasts, and at certain times of the year a still much larger number perish for want of nourishment. In very dry months in Africa, in the equatorial regions when there are no more roots and fruit to feed them, the monkeys die by thousands.

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* *Translator's Note.* — Wild animals of tropical countries, however, *rarely* breed while kept in captivity in our moderate climates.

We possess millions of sheep, goats, bullocks and horses simply because we lavish care on them, protect them from attacks by wild animals and especially because we provide them with food when there would be none to be found if the task were left solely to Nature.

Monkeys, being precious beings from which we can borrow fresh supplies of vital energy when it becomes necessary, should also be systematically bred. They would lend themselves to this perfectly. In India they are to be seen by hundreds in certain temples which are dedicated to them and in which they live on most peaceful terms with man. Have we not domesticated the elephant which, in the same country, is used for transporting tree trunks under the guidance of children?

It is necessary that monkey breeding farms should be established, just as we have breeding farms for sheep, and oxen. These might be organized not only in Africa and in Asia, their normal habitat, but also in the warmer of European countries, particularly on the shores of the Mediterranean.

During the course of my African trips I noted that, although it may be tropically hot during day time, the temperature drops down during the night, especially towards morning, to six degrees above freezing point (say 43° Fahr.) a temperature which monkeys living without shelter in the forests and plains are perfectly able to stand. In Algeria I have even found monkeys in the Chiffa gorges which are covered with snow in winter. They have become acclimatized, like the Gibraltar monkeys, and those on the high table-lands of Abyssinia. My scheme is therefore perfectly realizable.

As the discoverer of the treasure of life which monkeys can place at our disposal, I have considered it my duty to take the initiative by establishing the first monkey farm in Europe in order to set an example. I have organized it at the Château Grimaldi, on the Franco-Italian frontier, five hundred yards from Mentone, in an ideal spot which is sheltered by the mountains against the northerly winds and where the tropical vegetation proves the quality of the climate. There palm trees give fruit and bananas ripen.

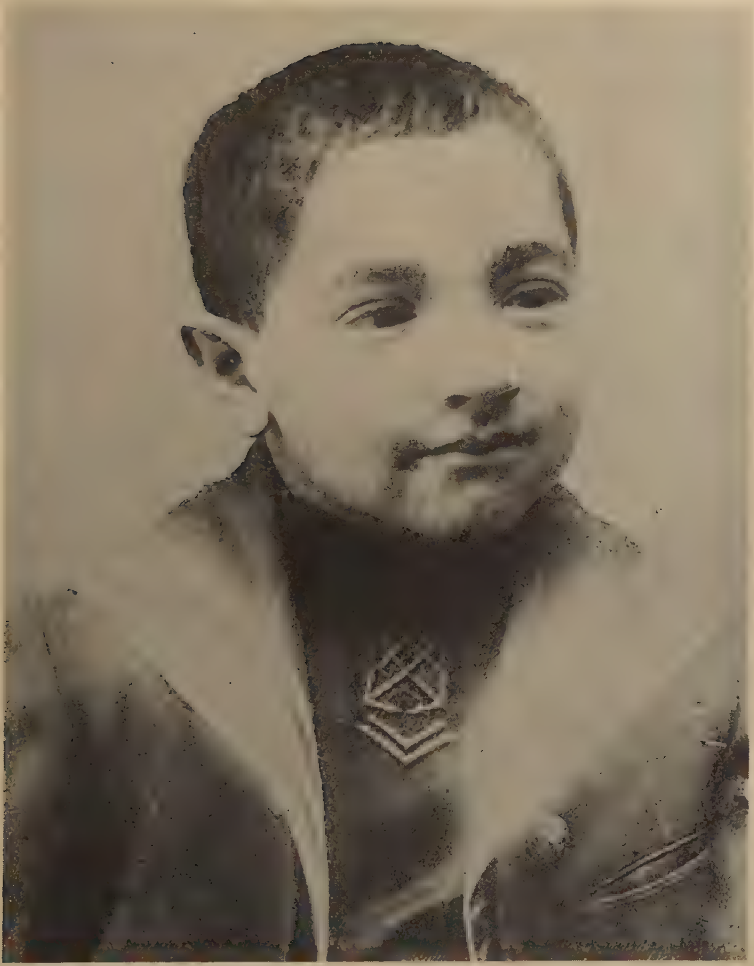
On my farm I have monkeys from all countries; they are placed under the best climatic conditions. During the night, in the winter months, the indoor cages are furnished with central heating which gives a mild temperature. Things are so arranged, however, that the monkeys can remain in the open air in outdoor cages, if they wish to do so. Those which, at the end of the year or two, will appear to be the most robust, will be placed in comparative liberty, among the rocks, in a large open space enclosed by wire netting that rises above the trees, and will live there both day and night, in order to become entirely acclimatized.

Arrangements have been made for giving the animals every opportunity for breeding. A monkey hospital has been organized in connection with the farm, in which the sick ones can be isolated. The farm has been in operation for twelve months, but the breeding department connected with it is of a more recent date.

The birth of two young cynocephalous monkeys has already been registered, and two others are to be expected shortly.

I am hoping that my attempt will be crowned with success and that I shall be able to demonstrate that the climate of the Riviera, both French and Italian, is suitable for the raising and breeding of monkeys. As time goes on and as my method for regenerating the human organism comes more and more into use, the service which these monkeys are able to render to mankind will be still better realized. The demand for monkeys, which already increases enormously from one year to another, will grow with time and their breeding will develop into a lucrative industry. What I have done for the purpose of setting an example at great cost in connection with the purchase and the maintenance of the monkeys, will become, for other people, an excellent business affair. At least, I hope it will, and I foresee monkey farms in the future, all along the Mediterranean coast, from Naples to Marseilles.

Each monkey may be compared to a workshop in which Nature, the great craftsman, turns out organs capable of being transplanted into the human body for the



Jean B. . . . , Fifteen Years Old, Before the Graft Operation He Underwent on December 5, 1913.

purpose of replacing the latter's worn-out ones. The monkey farms, then, will constitute great factories designed to supply spare parts for the human machine; the most precious factories man can possess, for they will hold in reserve the very elements essential to his life. Meanwhile, until the advent of that happy time, I am getting my supplies of monkeys from Western Africa and Abyssinia.

I have now succeeded in procuring regular consignments but, at first, I found great difficulty in getting a sufficient number of monkeys. Curiously enough, the first people who came to my help were the missionaries of the Order of the Holy Ghost, who are scattered all over the French colonies, where they are carrying on admirable work among the natives.

And the natives have much need of moral regeneration. In the Soudan I have seen some of these savages pass by a man who had broken his leg and who was groaning pitifully, without making the least attempt to help him. They went by just like animals would have done in a similar case, for their mental condition is at the same level. I have seen parents eat the whole of their provisions without leaving a crumb for their children. The so-called "lower animals" would have acted better.

To return to my missionaries: Their superior, Monseigneur Le Roy, who has written a remarkable work on our colonies and who is a man of elevated and broad mind, was the first to lend me his powerful aid. Father Maurice, who is a Doctor of Sciences as well as a priest, was instructed to go into French Guinea to investigate the best method of capturing chimpanzees without injury to them, and to bring back a complete report on the subject. He did more. Three months after his departure Father Maurice returned, bringing me five chimpanzees whose glands were used in my first human grafting operations.

My supplies of chimpanzees, since then, have no longer come to me through the priests but they have cost me prices that would have horrified those good, disinterested and humanitarian ecclesiastics. Breeding farms will put an end, I hope, to the sordid spirit of gain of the monkey merchants. Moreover, experience has shown me that chimpanzees, which are so delicate and rare, are not the only apes that can furnish the gland we require.

In view of the difficulty I found in procuring a sufficient number of them, I conceived the idea of resorting to cynocephalous apes, which are very abundant throughout the whole of Africa. Unlike the chimpanzees, which are monogamous and live in separate families, these monkeys are polygamous. They are very prolific and live in droves which are always led by a chief of tribe. The natives fear them, for they march in hundreds, destroying everything along their path. They are no easier to capture than chimpanzees, but they are so numerous that it is possible to secure them in greater numbers.

I used one of them for the first time on November 16, 1920, for grafting a man of seventy-four who was the most characteristic type of precocious senility. The

Jean B. . . . , One Year After the Graft Operation.

success I secured was so manifest and was marked by such a pronounced restoration of physical and intellectual faculties that I no longer hesitated to use the cynocephalus' glands as readily as those of chimpanzees. I get them from the Soudan, French Guinea and Abyssinia, and I have always about a hundred of these monkeys on hand ready to furnish grafting material.

CHAPTER ELEVEN

The Grafting of Men

MY METHOD of regenerating failing organisms by the grafting of simian glands proved to be good material for the authors of theatrical yearly "Revues" and for the song-writers of Montmartre. All these quasi-literary productions are brimming with facetious humor; for, in the author's mind as well as in that of most other people, the object and result of my grafting is to reawaken the amorous ardor that has been abolished by age.

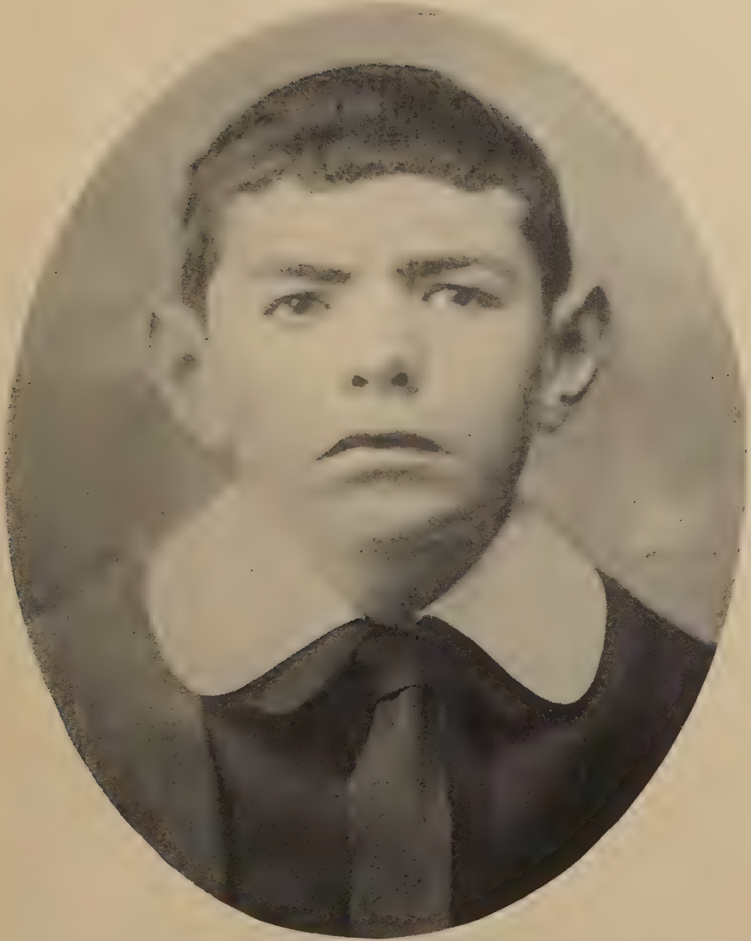
I have dwelt in many of my writings on the influence of the grafting process upon the intellectual and physical faculties, but songs and jolly stories are much more easily remembered than scientific accounts. The fact remains that, up to the present, there are many people who go into peals of laughter at the mention of the word "grafting", and who immediately begin to tell you some story regarding the remarkable feats of prowess of certain rejuvenated old men.

My duty is to bring matters back to the sober truth and to make what grafting really accomplishes well understood. When a man, whatever his age may be, comes to me to undergo the operation of grafting, it is because he is not yet dead. His brain, enfeebled as it is, still functions; his muscles still work sufficiently to permit him to walk, and all the organs necessary to the conservation of life continue to fulfill their duty, if only to an infinitesimal extent.

Now, such a man is certain to recover, thanks to the supply of a new source of energy borrowed from a monkey, his former cerebral faculties, his muscular strength, the vital energy of all his organs. So far as his interstitial glands are concerned, however, two alternatives may present themselves; in the first case, if these glands are merely much enfeebled, like all the aged man's other organs, they will benefit, like all the others, from the operation; there is no reason why they should not. It happens sometimes, however, with very old men, that the genital glands have become completely invaded by fibrous tissue, their specialized cells having lost all vitality and all aptitude for their function. In such a case grafting will have absolutely no effect on the glands so far as the genital function is concerned, whereas the cerebral and physical faculties will benefit enormously. The fact is that the grafting of a young gland gives back vital energy to enfeebled cells, but will not resurrect dead ones.

So much for the truth as to the action of grafting. It must finally be known, further, that grafting in no way is an aphrodisiac remedy, but acts on the whole organism by stimulating its activity. When the secretion from a youthful grafted gland gets into an aged man's blood, all the cells feel its effect, but those which react first are the most refined, the most delicate, the most sensitive, in other words: the brain cells.

This is the reason why the first indication of the success of a grafting operation is always the improvement of the memory, greater clearness of thought, more faculty



George P. . . . , Twenty Years Old, Taken the Day Before the Operation for Thyroid Grafting, Made on September 20, 1915.

for intellectual work. Then come the increase of muscular energy and of the physical strength in general, a sentiment of well-being, a renewed "joy of living", and that sprightliness which results from the perfect functioning of all our organs.

If the interstitial glands were simply very enfeebled, they recover the energy of adult age, like the other organs. If they are, so to speak, dead, there will be no resurrection. However, the joy of recovering his cerebral functions and his vital energy will amply compensate the grafted patient for the loss of a function which has ended its career.

Let me make it clear, at this point, that the belief which seems to exist that old men desire to undergo grafting so that they may recover their amorous aptitudes is pure legend. As a matter of fact, in order to gather something like a definite idea of the motive which underlies requests for operations, I have carefully looked over my own records, those of my brother Georges and of Dr. Dartigues, my constant co-workers, and those of Dr. Baudet, my former master and my earliest competitor, as well as those of Professors Marro, Thoreck, and others. Out of a thousand persons who have been grafted I have found barely sixty who have desired to undergo the operation solely for this particular reason.

And it is a singular fact, although a very logical one, that those who have submitted to grafting for this sole reason have been, not old men, but comparatively young ones, not exceeding fifty, who had been deprived of this function at a period of life when, as a rule, it is perfectly preserved. Such men are often those who have been born of elderly parents, and who have reached the age of puberty late, at between nineteen and twenty-two. Having always remained frigid, their sexual function has ceased quite early in life.

Others, as young men, have speedily exhausted the capital which Nature had given them, either through excesses, or overwork, or residence in enervating and depressing colonial climates. Towards others, again, Nature has been a cruel stepmother and has endowed them with inadequate organs. Lastly, there are others who have suffered from diseases which have affected these organs and weakened them early in life.

Really old men, too, over whom the amorous spirit exercises sway, never come to me for this motive alone. With age the diminution of the sexual function reacts upon the whole organism. The decline affects all the organs. After the age of sixty, muscular effort becomes troublesome, walking fatiguing, the memory shows lapses; prolonged intellectual effort brings on a weariness that is unknown in adult age, the imaginative faculty gradually dies away. Under the burden of all these signs of organic depression, the aged man pays little attention to his loss of sexual capacity but is anxious, above all, to recuperate the intellectual and physical forces necessary for continuing his work and facing the exigencies of life.

I do not know if there are any aged men who are so idle and unoccupied that intellectual and physical con-

George P. . . . , One Year After the Operation.

siderations do not count with them, and who are anxious only to recover the ardor that has been extinguished by old age, but none of them have ever addressed themselves to me or to my pupils. I do not wish, in any way, to express contempt for such a vital and legitimate function, by which Nature has realized the highest expression of happy union between man and woman. I merely wish to say that, apart from comparatively young men, who for one reason or another, have been deprived of this factor in life, aged men usually find in their condition of general depression other preoccupations than that of seeking merely the re-establishment of their weakened sexual power. I do not desire to check the song-writers or to influence the "Revues" which would lose in attraction if they were robbed of their peppery flavor, but I am anxious to make known the effects of grafting as they really are, for the benefit of people who wish to form an opinion based on serious data.

The first two men who were courageous enough to submit to an operation that had never been performed before and who consented to incorporate into their organism the interstitial gland of a chimpanzee, were an engineer and a priest. Both had had the misfortune of having been totally deprived of their own glands as the result of tuberculosis of these organs when they were between twenty-two and twenty-seven years old. I will overlook the case of the engineer and deal with the much more interesting one of the priest.

During the first years after the removal of his glands, he did not observe any marked change in himself. The internal secretion stored up in his body sufficed, in this case emasculation after reaching the age of puberty, to preserve the harmony of the vital functions. At the end of six years, however, every hair disappeared from his body. Fat invaded the tissues more and more, to the detriment of the muscles, and brought on greater and greater weakness. The memory became untrustworthy and intellectual work difficult. It happened that this priest was a famous preacher whose sermons attracted crowds of hearers, and he found a growing difficulty in exercising his ministry.

At the age of forty-two his weakness had so increased that he found it extremely difficult to remain standing for an hour. In order to conceal his affliction from his congregation, he made it a practise of kneeling several times during his sermons. In this, his hearers saw only a manifestation of great piety. And the poor priest, after thus resting for a few moments, was able to recover the thread of his thoughts and continue preaching.

The monkey's gland which replaced his own was, in this case, intended to serve a sacred cause by enabling a holy man to achieve his sacred mission among those whom he brought back to piety and to high moral principles.

We are, as you see, a long way from frivolous subjects, for the grafting of a monkey's gland, bringing new vital energy to an enfeebled organism can, as in the case just mentioned, have a result of high moral importance.

I had another priest among my patients, in this case a young man of twenty-eight, who was born with atrophied interstitial glands and who benefited greatly from this new stock of vitality. On leaving the clinic I was deeply moved when he told me "My first mass will be for you".

My laymen patients have included some not less interesting cases. Four years ago a man of sixty came to see me. He was a middle-class type, stout, heavy, slow of gait, and he told me a lamentable story.

Proprietor of a large factory employing three thousand men, in the valley of the Rhone, he had made quite a large fortune during the war by turning out all kinds of war material. Of a cultured mind, he brought together a magnificent collection of paintings in an historic château which he bought in 1917; he showed himself generous to his employees by providing them with houses and gardens and by assuring the old men and widows against want.

When the war came to an end, he transformed his munition factory into one for the production of agricultural machinery. Apparently, however, men are much more anxious to kill each other than to live in peace, for while the manufacture of bombs and grenades had enriched our man, agricultural machinery ruined him. In 1920 he fell into bankruptcy and was ruined. Losing his factory, he consequently lost both the château and the paintings. At the age of sixty he had to begin life over again. Completely demoralized, however, his old body and his fatigued brain had no longer the necessary energy for a fresh struggle. He complained of general weakness, loss of memory and of fatigue that every effort rapidly provoked. His arterial tension was very high; he was quickly put out of breath by walking. In this condition he felt incapable of any undertaking and he came to me to undergo grafting, as the supreme aid that might save him and give him back moral and physical energy. This was all the more necessary as he had a sick wife and a son who was a pupil at the Polytechnic School.

He was operated upon on June 19, 1922. I saw him again a year afterwards, and my surprise was extreme. I had not then yet performed many grafting operations. I had had but a few opportunities to observe what might be the results following the implantation of a monkey gland. The transformation which had taken place in this man gave me a sudden shock — but an agreeable one!

Instead of the stout, fat man of a year before, with hanging flabby cheeks and a heavy walk, I saw before me a young, slender, smart-looking man. I saw realized before me the legend of Faust, without the subject having had need to sell his soul to the devil.

My patient told me that, from the third month, he had felt a renewal of his whole body. He lost seven kilogrammes (just over fifteen pounds) without having changed anything in his usual diet. His general weakness disappeared, giving place to a feeling of strength, energy and well-being. Memory returned, with facility for intellectual work; he regained moral courage and felt the necessity, more and more imperative, of expending his energy. This former wealthy bourgeois, proprietor of factory and château, had bought a little Citroen and was scouring the northern provinces, selling gearing and spare parts entrusted to him by his old friends.

"I feel I have in me all the energy I had at thirty," he insisted, and I was delighted to see that his appearance confirmed this as true. Since then I have received from him news that is always more and more surprising. His activity has again become truly prodigious. He has established two garages for automobiles, bought an estate in Normandy and labors intensely, without fatigue. Three years after his operation, on May 15, 1925, he wrote me the following letter, which I reproduce textually, for it depicts eloquently the transformation which this man underwent: —

"My state of health remains perfect, and I feel like a *young oak*. I want to tell you some news that will please you. You remember my corpulency. I weighed 91 kilos (say two hundred pounds). All this excess weight has disappeared, and I do not now weigh more than 76 kilogrammes (say 167 pounds).

I can run easily for as long as I like. I can climb to the fourth floor without getting out of breath, just as I could climb when I was thirty.

I went out fox-hunting the other day at St. Etienne — very hard going up in the hills. I was always in front of many people much younger than myself, and I astonished them all with my staying power.

My power of resistance today is astonishing, exceptional. Never in my life have I been so well. I am never ill, and although I often pass the night in the train, I never feel the worse for it. Before I was grafted I was short of wind and puffed for no reason at all, or for very little. At present, *so far as strength is concerned, I am still only twenty-five.* I simply cannot feel fatigue.

Your operation has proved marvellous. I do not know if it has had the same effect on your other patients, but for me, from the general point of view, it has proved most salutary."

In 1923 his wife died. The poor woman had been the inmate of an asylum for many years. In 1926, four years after the grafting operation, my patient, having recovered all his youthful strength, remarried. He did me the honor of asking me to be one of his witnesses, and I signed the marriage register at the Marseilles City Hall in that capacity. The Deputy-Mayor, a man of forty, received my signature with an air of satisfaction which gave me the impression that he looked forward to his later years with more assurance than formerly.

Many other cases have been registered in which grafting has rendered equally valuable services, although of a quite different kind than merely restoring virile power. Thus, for example, with my friend Dr. Baudet, the eminent surgeon of the Bichat Hospital, and Dr. Georges Voronoff, I performed a grafting operation, on May 22, 1923, on a professor of law attached to one of the French provincial universities. Aged sixty-eight years, the patient desired to be grafted in order that he might be able to continue his duties until he reached seventy, when he should then be entitled to his retiring pension. Lecturing, as a matter of fact, had become very difficult for him. Affected with great general weakness, which was aggravated by senile trembling of the hands, he was faced with necessity to resign his post unless the grafting operation proved a success. His hopes were fully justified.

In reply to a letter from me, asking for news as to the outcome of the operation, he replied to me on February 27, 1925 (about two years after the grafting) in the following terms: —

> "I was placed on the retired list as from November 1st last (at the age of seventy). As I have sufficient strength, to which fact your operation so much contributed, and as that operation gave me, in addition, confidence and a very satisfactory *morale*, I did not hesitate to come to N—, to find something in the way of occupation.
>
> I work all day, without neglecting outdoor exercise. I sleep very well.
>
> You see, my dear Doctor, that my news is good. Generally speaking, the people I meet congratulate me on my good appearance. In this connection I want to tell you that Dr. B. de S. whom I have acquainted with my case, declares that I certainly look much better since the operation."

I may add that, together with Dr. Baudet, I have observed a progressive improvement in the handwriting of this patient after the operation. The letters we received reveal that, from being very trembling before the graft, the writing afterwards became more and more firm.

Not less interesting have been the cases of most of the doctors who have asked to be grafted, in order to restore their failing energies and enable them to continue the exercise of their profession. I have been able to render this service to more than fifty of my colleagues, and this is perhaps the greatest moral satisfaction my work has brought me. I have rejoiced to see their scepticism of earlier years transformed into such confidence that they come themselves to perform the most unquestionable act of faith by asking me to renew for them their own intellectual and physical capacities. Among the number I can include a venerated master, one of the glories of French thought, whom I grafted at the age of eighty-three, with the assistance of Drs. Baudet and Georges Voronoff. He is the dean of all those who have undergone the grafting operation. He is at present eighty-seven, and his increased vital energy justifies me in hoping that he will be the first to pass the century mark and thus prove that grafting really prolongs life by augmenting the resistance of the organism.

I was able to render the same service, two years ago, to the Dean of the Faculty of Medicine of a neighboring country. Although only sixty-two years of age, he experienced a constant fatigue and lassitude, the consequences of too strenuous a life, and he feared that he would not be able to remain equal to the task that had been entrusted to him. The operation helped him to recover the full energy of former days and he has since been prodigal in his manifestations of gratitude to me.

I have operated on other less famous doctors, whose lives have been also devoted to doing good. One of them, now seventy-seven years of age, a former senator, complained of general weakness, failure of memory, and of minor infirmities common at that age. He greatly benefited from the operation, which I performed on March 21, 1923, in collaboration with Drs. Dartigues, Didry, Moutard and Georges Voronoff. Four years have now lapsed, and the improvement in his condition has been maintained from every point of view. In one of his last letters, this patient informed me that his memory has improved and that "the general effect is that of a very evident rejuvenation," namely, the skin less dry, a more upright carriage of the body, more activity in the movements, a hitherto unknown sense of well-being.

On March 19, 1923, in collaboration with Drs. Dartigues, Didry and Georges Voronoff, I operated on a Spanish surgeon of great renown, who was then aged sixty-seven. From details which he supplied to me before the operation, I extract the following as the most significant passages:

> "I have labored enormously, both professionally and intellectually.
>
> During the past two years I have been easily fatigued. I am gloomy, broken-down, spiritless, but I have been able, thanks to my strength of will, to continue more or less satisfactorily to follow my occupation.
>
> For some time — three or four years — I have been dreading major surgical operations that I formerly performed with ease and perfect serenity. My memory has deteriorated, and so has my physical strength in spite of the fact that I used to be an athlete."

A fortnight after the operation my distinguished colleague returned to Spain, and he has since kept me informed by periodical letters as to his condition. These letters depict so well the succession of phenomena observable after grafting that they are of great documentary value. I quote some of them textually:

"August 19, 1923. — Three months have elapsed since the grafting, and I have not yet observed any very appreciable changes. Nevertheless I feel better, and I am a little more alert; that is all.

September 14, 1923. — During the past fortnight I have been feeling stronger, younger, I daresay.

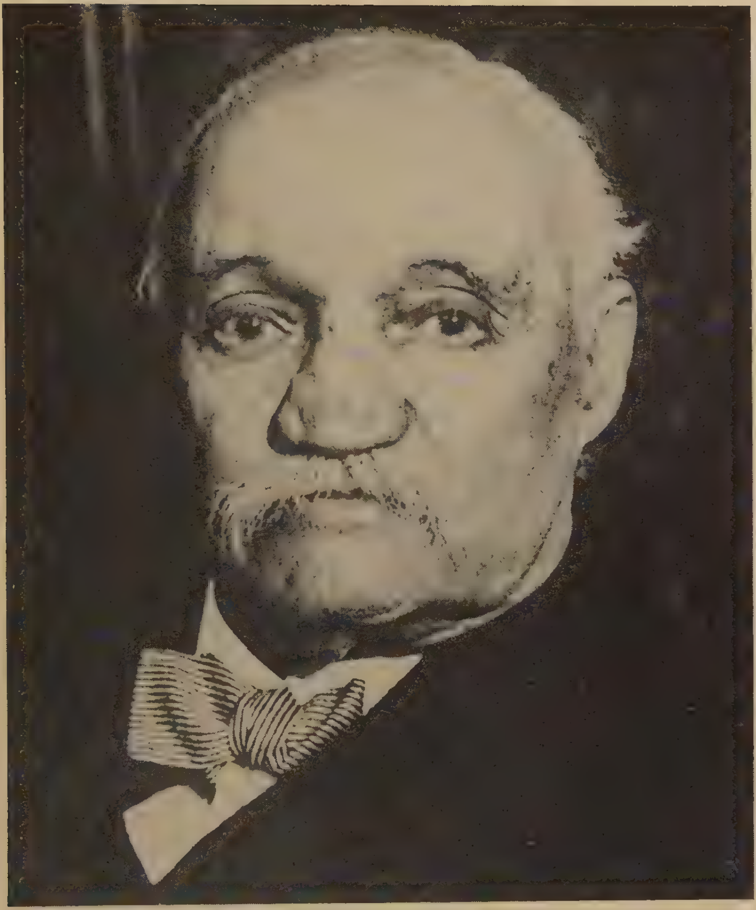
November 8, 1923. — I have the pleasure to inform you that the beneficial effects of your graft make themselves felt more and more. I feel stronger and in better spirits. My resistence under the pressure of intellectual and physical work has increased."

I will quote, finally, from his last letter, dated January 1, 1926:

"Since my operation I feel really more sprightly, more energetic. My capacity for work has increased, and also my memory. My face, from what I am told, is not aging; on the contrary, I look younger."

It was this colleague who gave me the opportunity, three and one half years after the operation, to investigate the state of the gland that had been grafted, and to observe its perfect vitality.

Neither can I fail to mention the excellent results



Mr. L. . . . , Seventy-four Years Old, Before the Grafting Operation.

obtained from the grafting operation made on May 1, 1924, on one of the most popular members of the Institut de France, then seventy-seven years of age. This "immortal," in spite of his age, was continuing his labor on a very important work, but strength was failing him more and more, and the fear that Death would overtake him before he had accomplished his task was rendering him really unhappy. The operation I performed on him three years ago has not betrayed his hopes. In reply to my inquiries he wrote me several letters which set forth his experience much better than I can do, as the following extracts will show:

"Intellectually — and you are aware that it was this which concerned me — I thought I had observed a certain weakening of my memory. From time to time proper names that were well known to me escaped my recollection. In my personal work and researches there was nothing abnormal, except that when I had to read a complicated work that was rather long and of a scientific character, requiring sustained attention, I was subject to fits of abstraction or inclined to drowsiness."

"What now strikes me particularly is that my mental activity has been intensified. I work better than ever and without appreciable fatigue. My memory, which showed lapses is equally better."

"I continue to enjoy good health. What will interest you more particularly is that my intellectual activity has never been greater than last winter, as you can see for yourself by running over the pages of the revue which I edit, the "Bulletin de — " and the "Revue — "

"A week ago I walked from here to the county seat between three and four miles distant, and came back the same evening, without serious fatigue."

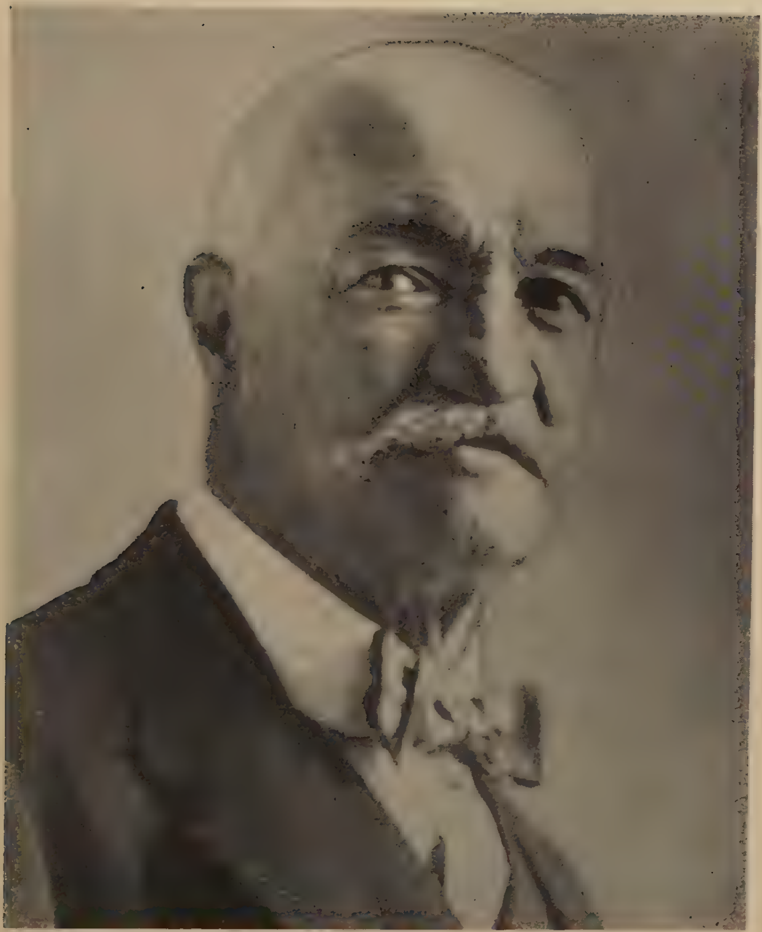
"I have been in the habit, for a long time, of rising between six o'clock and half-past, but not, as a rule, without effort on my part. Now I don't mind it at all, and I get up thoroughly fit."

"I am working hard. I have some heavy work in hand, for which I have collected a good deal of material. I hope to be able to bring it to a good conclusion, God helping me, thanks to the aid of Dr. Serge Voronoff."

"I am able to inform you that my mental activity *has never been better or more efficacious.*"

What finer recompense could ambition have led me to desire than that of being able to give to such men the physical and intellectual energy necessary to complete work by which the whole of humanity is bound to profit?

For a long time I desired to apply my method to the aged men in our public institutions, in the hope of enabling some of them to recover enough strength to resume, for some years, an active life, instead of remaining a burden to society. The Prefect of Algiers, M. Alliez, realizing the social and economic value of carrying out such a project, was the first to lend me help in this direction. The results obtained in the case of an aged man in the Douera Asylum, near Algiers, and in others which I examined in institutions in Turin and at Alba, in association with



Mr. L. . . . , Seventy-seven Years Old, Two and a Half Years After the Graft.

Professor André Marro, were so remarkable that an extensive application of my method in institutions of this kind may be foreseen.

The first of these cases concerned an Alsatian named Georges Behr, born at Mulhouse, in November, 1851. A long life of hard work and privation had left its imprint on this poor old fellow who, at seventy-three, looked as if he were eighty; body bent and shrivelled up, gait unsteady, sottish look, considerable emaciation, general appearance of great physiological destitution.

The grafting was performed on March 5, 1924, at the Algiers General Hospital, by Dr. Cochez, assisted by his chief of clinic, Dr. Pieri, in the presence of the Prefect and a large number of local surgeons and doctors. My rôle was limited to ensuring the correct execution of my technic.

The monkey from which the gland was obtained was a large Algerian magot, a kind of tailless monkey of the macauco species. This is of particular interest, for it was the first time that a monkey of this kind was used for the graft. Hitherto I had had recourse solely to chimpanzees and cynocephalous.

A year later, on April 7, 1925, I went to Douera again, accompanied by M. Dubief, General Secretary of the Algerian Government; M. Maury, his Chief de Cabinet, MM. Alliez and Lamy-Boisrozier, Prefects of Algiers and Constantine and Drs. Cochez and Pieri. The surprise of all of us at the sight of the aged patient was extreme.

Georges Behr was literally unrecognizable. Instead of the pale and debilitated being, with wandering eyes, hollow cheeks and pitiably shrunken body, we had before us a man with a full jovial and ruddy face, sparkling eyes and a general appearance of excellent health. I learned that, three months after the grafting operation, he had obtained employment with M. Pommerau, a Douera druggist, where he spent his time washing bottles, raking the garden paths and looking after the animals in the poultry yard, and that he endured these occupations without trouble. His mental improvement was equally manifest. To the various questions put to him he replied with vivacity, and even with a certain amount of humor that contrasted sharply with his faltering words, enunciated with so much difficulty before the grafting.

It is now over three years since this man was operated upon and he still retains the advantages of the grafting. His last photograph, which was sent me by Dr. Cochez, eloquently confirms that the effects of the young monkey gland remain intact.

The old men who have been grafted in the Turin and Alba institutions have similarly benefited. As I was more especially interested in one of them, I asked Professor Marro to write stating how he was getting on. Here is his reply:

"I am glad to give you good news of the sixty-year-old barrister who is an inmate of the Charity Hospital at Turin, and who was operated upon by you five months ago.

As you will remember, he was an alcoholic subject, who appeared to be in a state of pre-dementia indicated by the continual rocking of the head and automatic movements of the extremities, and also because of his feeble imagination and his use of uncompleted phrases.

Querulous, unfit for work on account of general weakness, with trembling hands, defective memory, tormented by insomnia, without appetite, he had for eight years lost the *libido potentia coeundi.* Blood pressure, 180; cyanotic hands, and cyanotic spots all over the body; adipose tissue and atrophied muscles; weight, 125 pounds; height, 5 ft. 7 in.

Today his aspect and characteristics are profoundly changed, and the metamorphosis which has taken place in him, especially during the past two months, promises to give brilliant results.

He has already recovered the well-being of former days. He has a great appetite, the muscles have gained in tone, the trembling of the hands is attenuated, the rocking of the head has ceased. He carries out perfectly and with good will commissions for the hospital of which he is an inmate, but he wishes to leave as soon as possible.

Sexual sensations re-awoke two months ago and, although he places no value on such matters, which he regards as things of the past, he states that he "feels like he did when he was young," and that he again has a sense of appetites from which he wishes to be free owing to the special situation in which he is.

His weight has increased by nearly seven pounds. Blood pressure has diminished to 132. The cyanosis in the hands is observable after meals. The cyanotic spots on the body have almost entirely disappeared.

He still suffers from insomnia at times, complains of his feeble memory, but these phenomena have also become attenuated.

I am endeavoring to second his idea of leaving the hospital by securing him employment, and I am hoping that the mental benefit which he would derive from it, coupled with the physical improvement brought about by the grafting, would soon bring about a wonderful result."

Among literary men, novelists and dramatic authors, whose works of imagination call for much application and a constant expenditure of nervous energy, it is interesting to note the effects of grafting on the intellectual faculties. I will cite three typical examples.

M. Ch. M —, now seventy years of age, who was referred to me by my friend Professor Gabriel Petit, was operated on by me, in collaboration with Drs. Moutard, Didry and Georges Voronoff, on March 21, 1923, or over four and one half years ago. As we shall see, the benefits from the grafting persist intact to this day. I cannot do better than leave the patient to speak for himself, as to his condition before the operation. This is what he has written:

"I cannot say that for a man of my age, I don't feel well. However, my memory, which was extremely good, has become very poor. Of course, my working capacity has correspondingly diminished. I can hardly concentrate my thoughts. For instance the writing of a long and intricate novel would be extremely irksome. After having been quick in everything, of untiring activity, my movements are slow and I get rapidly tired. After having formerly been used to deliver lectures I would now suffocate in the atmosphere of a public meeting.

To be sure I do not believe that I am yet in my dotage. As I am not apparently afflicted with any organic trouble, I think that I could still vegetate tolerably well for two or three more years. But I wish to submit myself to your grafting in order that I may not mentally decline too much, that I may still be able to read and write and keep posted on intellectual and social topics."

On May 18th, two months after the operation, I received the following laconic note:

"Health excellent, but nothing more."

Then on June 26, 1923, I received this:

"Although this is a somewhat special subject, I must inform you, as a matter of record, that there is an appreciable awakening of my sexual function."

Some confidential details were given in support of this statement.

On September 26, 1923, six months after the operation, I saw M.C.M. again. He had become noticeably thinner, was quite sprightly and could take long walks without feeling tired. His appetite was excellent. Intellectual work was easier. He experienced a feeling of well-being which he had not known for some years. He looked younger.

On November 7, 1923, M.C.M. wrote me:

"You may not only publish my photograph, but you may also print my name in full. Today, seven and a half months after the graft, here is what I actually observe:

A welcome loss of seven kilogrammes (15½ pounds) general toning up, physical alertness, and disappearance of my rheumatism."

On March 25, 1925, I received a letter from which I extract the following passage:

"I was grafted two years ago today. It is my duty to inform you as to my present condition. The beneficial effects were somewhat slow in appearing, but as those around me may testify, they are quite marked; you found the right word when you said that the graft "toned" me up.

The most remarkable result was the disappearance of my rheumatism, acute attacks of which sometimes kept me laid up for several weeks; now I only feel a disagreeable sensation in my feet when there is a change of weather. No more swelling as I had before and which prevented me from putting on shoes and climbing steps.

Another fact worth mentioning: I do not feel as drowsy as I did before. It is now 11:30 P.M. and, on the night before last, I kept on writing till 1 A.M."

Finally, on December 26, 1926, M.C.M. wrote me:

"With the exception of rheumatism, which has returned with this abominable spring, after having been almost entirely checked for three years, I remain 'tonified', and I hope to find myself in good form for the trial of the Catalonians, where I am going to give evidence as character witness, in favor of the accused . . .

In a year and a half I shall have been grafted five years. At that time we shall see if it will be necessary to 'recharge' me."

The second literary man whom I should like to cite was a man of sixty-three, who had been suffering from hemiplegia of the left side for some two years. Systolic arterial pressure: 20 to 22. I operated on him on October 7 at the Ambroise Paré private hospital at Neuilly, assisted by my brother Georges and Dr. Dartigues.

The first results of the operation were felt at the end of about three months. The patient, who had been very much affected by the attack of hemiplegia and had become neurasthenic, resumed his former good spirits and felt, to use his own expression, as if "enveloped in a feeling of general well-being."

His blood pressure, which, within three months after the operation went down to 18, dropped some time later to 15. In addition to this, his left arm and leg, which had been paralyzed since 1922, were greatly improved. He is now able to take long walks, and uses his left hand as before the paralysis, though somewhat more slowly.

He recovered his appetite and the enjoyment of living, and was able to take up literary work again, which he had had to abandon after his attack of hemiplegia and the general enfeeblement of his organism, in spite of the medical treatment which he had undergone.

At present (July, 1927) he feels stronger and has the appearance of a man of barely fifty. He has the keen look and the full and musical-toned voice of his youth, much to the astonishment of those who knew him after his attack of hemiplegia, when he was speaking with a half-inaudible voice.

On December 31, 1926, I received from him a letter in which he expressed the benefit which grafting had procured him:

> "Another year has gone by, and I am happy to be able to send you with a ready and active pen, my most sincere wishes for 1927. *Thanks to you my dear Master, my state of health continues always to improve.*
>
> I am anxious to repeat this to you at this close of the year, as I know to what extent you are interested in your patients, to whom you have restored health and whose lives you have saved (*as in my own case*). If I am still alive, after the terrible malady which overwhelmed me a few years ago, if I continue to enjoy marvellously good health and to work like a young man, I owe it, my dear Master, to your wonderful grafting and to your great kindness to me.
>
> When I first came to you, I was an unhappy sufferer, contemplating suicide. A year later, you were able, yourself, to judge the results of your operation. You saw me well and in excellent health, gay and filled with the joy of living. If I were a religious man I should say: God will reward you in heaven."

I will cite lastly the case of a dramatic author, now seventy years of age, who has undergone two operations. The first one was performed seven years ago, in collaboration with Drs. Didry, Moutard and Georges Voronoff, on November 16, 1920, and the second in collaboration with Drs. Didry and Georges Voronoff four years ago on June 13, 1923.

Seven years ago this writer presented a well-characterized type of precocious senility; aspect of an old man, flabby cheeks, wrinkled face, shrivelled body, dull eyes, with corneal senile circle. All physical effort was so wearisome that he was compelled to sit down for his morning toilet. His gait was slow and shuffling: great lassitude. Thought was difficult and laborious. The failure of the memory was more and more marked. Imagination had become sluggish and his literary productions suffered from this condition, with the result that this once brilliant mind was painfully affected.

Record of this case, two years after the operation, contained the following note:

> His body has become erect, the facial muscles firmer, the eyes regained their brightness, and, in spite of his white hair, he gives an impression of surprising youthfulness, vigor and energy. He has resumed his former habits, his walks, his frequent attendance at the theatre. But what fills him with joy is that he has recovered the fluency of expressing his thought and the ability to work long hours without fatigue.

This condition lasted nearly three years, during which my patient not only enjoyed all his reconquered faculties, but greatly abused them. To my often repeated advice that he should spare his strength he always made the same reply; "When I shall have exhausted the potency which you have given me, I shall beg of you to repeat the operation, as you have done for your aged rams."

As a matter of fact he insisted, in May, 1923, that I should give him the benefit of a new grafting, telling me that, without having fallen back into the condition in which he had been before the first operation, he no longer felt "that overflowing energy" which he had experienced until shortly before the time when he made his present request. I allowed myself to be all the more easily persuaded to accede to his wish because the experiment was a tempting one, which I had not until then had the opportunity of making in the case of a man.

On June 13, 1923, I performed a second graft. On the following October 3d the patient wrote to me in the following terms:

> "The result, this time, has been slow in making itself felt. The effect, which after the first operation, showed itself at the end of about two months, did not, on this occasion, recur at the end of the same lapse of time.
>
> Now, however, four months after the operation, I have recovered strength equal to that which you previously gave me back. I once more owe to grafting my present better moral, mental and physical condition. Five weeks ago there also occurred a realizing of the local condition. Finally, I have been able to work, and the libretto which I have drawn from my last play is nearly finished, with a prologue which I have added."

At present, seven years after the first operation, and four years after the second, my patient, at 73 years of age, certainly looks better than when he was 63. He shows off splendidly, travels continually, superintends the staging of his plays and the rehearsals, expends an enormous amount of energy, and, to put it in a nutshell, accomplishes an amount of work which he would have been absolutely incapable of doing seven years ago.

This case and several similar ones prove the inanity of the fear that, after the exhaustion of the grafted gland's action, the aged man would fall back to a lower condition than before. This opinion, which no fact confirms, is absolutely erroneous. The internal secretion of a youthful grafted gland does not act like a flash of lightning on the old organism, nor does it in any way burn out the tissues.

The effects of this secretion are shown by the multiplication of the cells, and their more active renewal from which results the increase of vital energy.

When, at the end of a few years, the effect of the graft has become partially exhausted, the organism, thanks to the acquired vigor, finds itself in a better state than it was before the grafting. This explains why the second graft finds again the proper soil in which to exercise its action in the heart of the tissues to stimulate cellular energy and re-establish harmony in the organic functions.

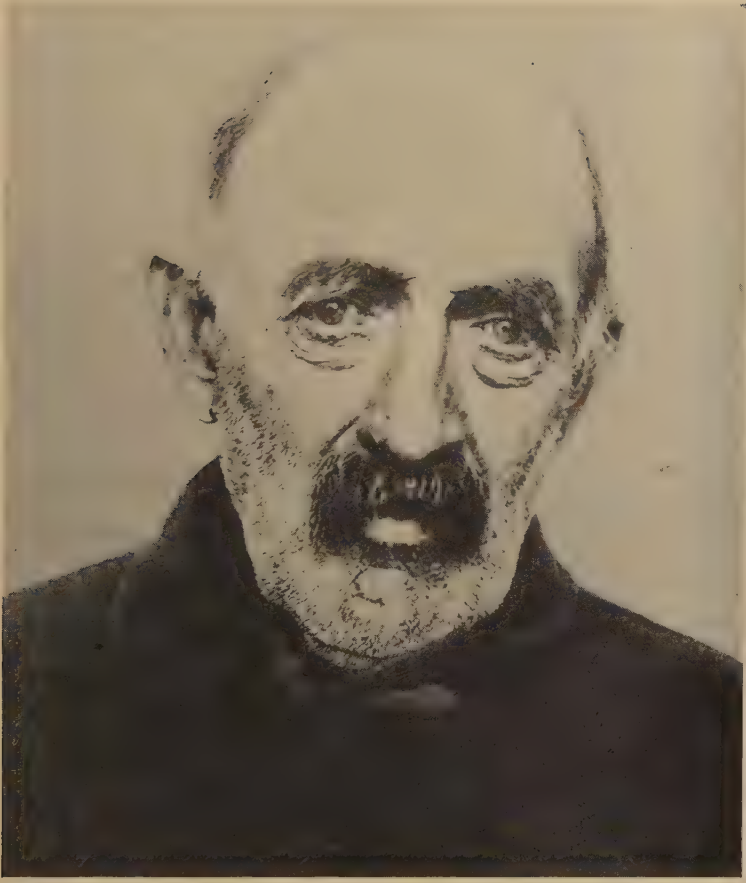
The future will teach us how many times the graft may be practised, each time giving our organism the benefit of a tonifying secretion issuing from the young interstitial gland.

What I can already affirm is that a second graft, which has now been practised in the cases of half a score of individuals, five or six years after the first, gives positive results in every way similar to those conferred by the initial operation.

Auto-suggestion, which is sometimes invoked for the purpose of explaining happy and undeniable results, plays no part in the matter. Auto-suggestion, imagination, hope, or faith cannot replace a deficient gland, cannot transform a man rendered impotent, feeble and depressed by age into a vigorous individual, able to enjoy, for years, physical and intellectual faculties that have been abolished or diminished for a considerable time.

Auto-suggestion cannot produce phenomena which depend specially on the interstitial glands' internal secretion, such as the loss of obesity through better assimilation, the reduction of blood pressure, the improvement, and even the cure, of prostatitis and of the increase of muscular strength, the re-awakening of memory and of the intellectual faculties, the revival of sexual functions that have ceased for some years. Auto-suggestion might, after all, and only during the first few months following the graft, bear a certain part, provided we concede that the old man's faith could still find within his depressed nervous system sufficient influx that would cause some delusive phenomena. But that this faith, this auto-suggestion might continue for some years to replace the absent internal secretion would be more than auto-suggestion: it would be a miracle!

The succession of phenomena that I have observed after all the grafting operations and that the Spanish surgeon has so well set forth in the letters which I have quoted, shows further that auto-suggestion has nothing to do with the matter. The action of the graft being unable



George Behr, Seventy-three Years Old, Taken Before the Grafting Operation.

to show its effects until two or three months after the operation, when the grafts themselves have acquired sufficient vitality, no notable change is in reality to be observed in the condition of the grafted patient, and none is due to auto-suggestion.* On the contrary, some of the less well informed patients, not finding anything definite apparently happening, begin to worry and to despair of receiving any benefit from their operation. Their delight is all the greater when afterwards, they are able to report the development of evident symptoms of new energy, as indicated in various ways. These manifestations reach their height at the end of about a year, and are maintained for five, six or seven years. In some cases they even increase during the third year.

Aged animals that undergo grafting respond in exactly the same way, and in their case it would be absurd to think of auto-suggestion. One might as well attribute the birth of their young to that psychic agency. Grafting, therefore, is followed by a real and incontestable benefit, which is prolonged for several years and may be renewed.

Now, is it not an enormous advantage — at the age where all the faculties have waned, when the memory has become unreliable, thought slower, muscular effort arduous, when all the impetuosities of life are subdued and some of them died out entirely — to recover for some years the full possession of all the faculties characteristic of adult age, and drive back to a correspondent extent the depression of old age and the spectre of Death?

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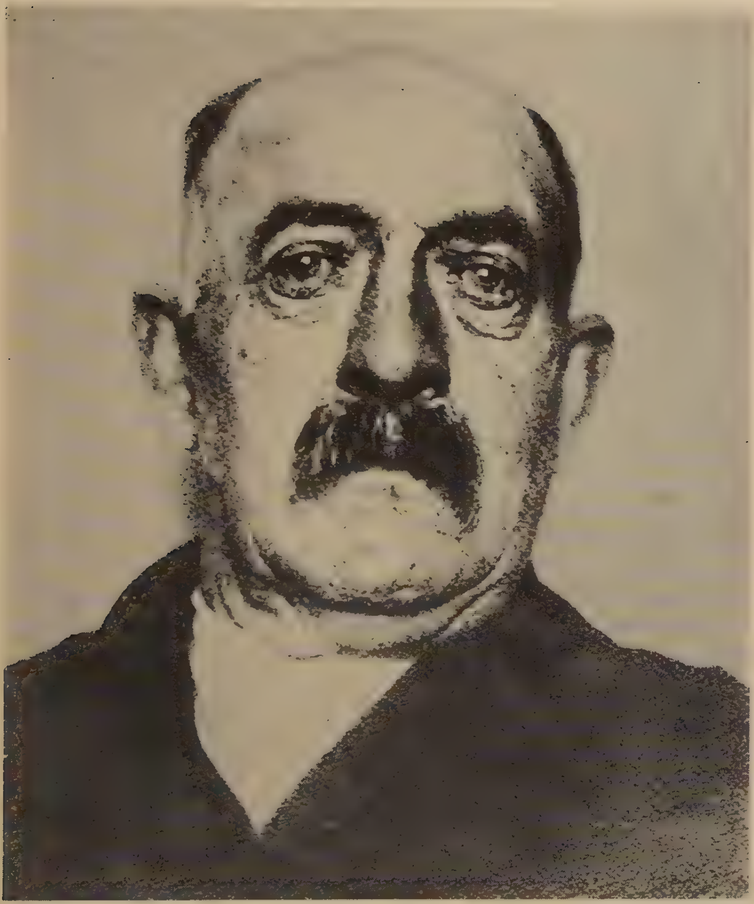
* *Translator's Note.* — I have seen a Javanese Physician in whom the first effects of the graft undoubtedly manifested themselves about four weeks after the operation.

The earlier help is brought to the enfeebled organism, the better will be the results and the longer they will be maintained. In all grafting operations the graft itself must be taken into consideration, and also the ground in which it is transplanted. The less exhausted this ground is the better it will nourish the transplanted graft. We are all inwardly aware of the moment when decline begins. It is impossible to go against the stream and the falling off gradually increases. We glide down a fatal slope, and it would be unwise to wait until we have reached the bottom before trying to climb up.

Now, I would like to go a little deeper into the subject. Since it has been demonstrated that a youthful animal grafted according to my method acquires higher qualities, that its organism becomes more vigorous, that its vital energy is enormously increased, why should we not also go so far as to graft intelligent and really gifted children, in order to intensify the qualities of their organism?

By grafting young lambs we have succeeded in developing super-rams. Why not try creating a race of super-men, endowed with physical and intellectual attributes very superior to ours?

This conception may appear strange and somewhat revolutionary at the present time, but there is no reason why such an attempt should not be made. Grafting is an absolutely harmless operation, involving no danger what-



George Behr, Seventy-seven Years Old, Four Years After the Graft.

ever, and which can be made without general anesthesia. The first mother who would entrust me with her child for this purpose might perhaps contribute a new chapter to the history of humanity.

CHAPTER TWELVE

The Grafting Operation for Women

AND what about women? When they reach the age at which their strength begins to fail, when decrepitude comes into evidence, are they to be left to glide down the fatal slope?

They are more fearful of old age than we are. If they are called upon to expend less energy during their lives, they are none the less anxious to preserve all their activity. Plastic surgery has made such progress that it is easy to repair the devastation that years bring on to our gentle companions' physiognomy. The only women who are now to be seen with wrinkles are those who are ignorant of the resources which surgery places at their disposal, or those who have lost all desire to please.

To recover the beauty of features which she possessed at thirty and the abundant vitality which displayed itself through the suppleness of the body and gracefulness of movement is equivalent, in a woman, to retrieving the joy of living; but how ironical it would be to resume the features of youth and have to retain the graceless body of the woman of sixty!

I should not advise women, however, the grafting of a man's interstitial gland. This would probably endow them with fresh vigor, but what they would gain in strength they would lose in gracefulness and in feminine sentimentality.

I have observed, as a matter of fact, after such grafts on female goats and sheep, a sort of perversion of the maternal instinct; that is to say, an alteration in their psychic condition, in their sentiments of affection. They looked upon their young, when they were first born, with a sort of surprise, and refused to suckle them.

The body of women also might undergo changes no less unfavorable to them. The interstitial gland of man influences the outward signs of virility — moustache, beard, deep voice, — all of which woman has no desire whatever to acquire. She has no need, moreover, to borrow from man something foreign to her own organism. If, in her youth, she displays such an exaltation of all her faculties, such an overflow of vital energy, it is because she possesses a gland of her own which is analogous to the man's interstitial gland: the ovary. As is the case in men, woman's vital power corresponds with her period of most intense sexual life, and there is a direct correlation between the ovarian function and that of all the other organs.

In reality, the operation of ovariotomy practised on young women who are still far from having passed the period when motherhood is no longer possible, diminishes their vitality, slackens the nutritive functions (which is the cause of the abundance of adipose tissue in such cases), and often brings on psychic disturbances. These changes are less noticeable during the earlier years after the operation because the organism is then still benefiting from the ovarian secretion that had been stored up by the tissues; but in the long run, the symptoms become accentuated

Mr. Charles M. . . . , Sixty-six Years Old, Taken Before Grafting.

and the unpleasing effects of the premature arrest of normal functioning shows itself in all the manifestations of intellectual and psychic life.

The period when a woman definitely loses the capacity for becoming a mother marks for her the beginning of old age. The eyes lose their sparkle, the body waxes heavier, the movements lose their earlier grace, and the relaxation of the muscles of the face causes the formation of wrinkles. To such women the ovarian graft brings about a transformation that is sometimes wonderful. Wiser and more coquettish than men, women prefer to remain young rather than to re-become so after displaying all [the unpleasing signs of old age. As a rule, they ask to undergo grafting at an earlier period than men — at the time of the change of life; and the results are so much the better. Monkeys again furnish the grafting material, but, in this case, I borrow the youthful ovaries from the female chimpanzee.

My first ovarian graft on a woman dates from 1924 and it was made with the same object as the interstitial graft on man. The woman, who was sixty-four years of age, had been a widow for twenty years. She had a blind son of thirty, from whom she wished never to be separated. Having no private income, she had succeeded in earning her son's living and her own by literary work, — translations, newspaper articles, and so on. As age advanced however, she became more and more easily tired, and steady intellectual or physical work became difficult. Old age came, bringing the breakdown of the body and general enfeeblement. To climb the stairs to her sixth floor flat became a torture; working till late hours left her exhausted. Her earnings were diminishing, poverty was facing her, and she came to me with a cry of distress, asking me to restore her strength and her energy for work, in order that she might be saved from definitely sinking and being thenceforth unable to support her son.

The grafting of an ovary from a female chimpanzee on June 10, 1924, which I performed with the assistance of my friend, Dr. Dartigues, the well-known gynecologist, and Dr. Georges Voronoff, literally transformed this poor woman. I saw her again for the first time six months after the operation. Her figure had again become erect, her movements alert; the face no longer wore the expression of pain that made it look so old; the wrinkles, further, were much less marked, as the result, evidently, of the better tone of the muscles which is always to be observed after grafting. But what rejoiced the worthy woman more was that she was again able to climb lightly her six flights of steps, work twelve hours a day, and feel in herself a renewed strength which restored her moral courage to face the struggle for life.

It is now three years since the operation was performed, and the beneficial results continue to be felt, to the patient's intense joy and to my own satisfaction; indeed, I am profoundly grateful to her for having been the first woman to give me the opportunity to observe the changes that may result from the grafting of a young ovary in an aged woman's body.

Mr. Charles M. . . . , Seventy Years Old, Four Years After the Graft.

Since then I have performed the same operation on other aged women. Among them was an American lady, sent to me by Dr. Walker, and who, at the age of seventy-two had the intention of marrying for the sixth time. The case was a rather unusual one, for such a disposition was evidence of a moral courage far above the common run and a buoyancy of sentimentalism denoting an exceptional nature.

The greater part of my feminine patients, however, have been women whose ages have varied from forty-five to fifty-five and who were either approaching the critical period of life or had just passed it. Their wish was to remain young, or rather to become still younger. They were quite right. The results to be obtained in such cases are excellent from every point of view.

I will quote as an example a Brazilian lady, from San Paulo, whom I grafted at the age of forty-eight. When she first came to me, she said: "My husband has left me, because he found me too old: therefore I took the first steamer to come and get rejuvenated by grafting."

Not being her husband, it was not for me to pass such a judgment. I had to recognize, however, that she was suffering from a really exaggerated degree of *embonpoint*, and certainly looked her forty-eight years — perhaps a little more. Fat caused her body to be shapeless and her face, with its flabby cheeks, had an exaggerated contour. I felt that, in this case, grafting had a high moral value, inasmuch as it was destined to rejoin sacred family ties and enable the wife to reconquer her cruel husband by her renewed charms.

The graft which was performed on July 15, 1924, gave results that exceeded my greatest hopes. Without changing her diet in any way, my patient lost 16 kilogrammes (over 35 pounds) during the first four months. Instead of a formless mass of flesh appeared a charming person. As the fat melted away, the muscles became firmer, the face took on a youthful expression, the eyes glowed with the light of happiness.

I kept in touch with her for several months and I observed an incontestable progress in the rejuvenating of this woman, at which I rejoiced both for her sake and her husband's. I did not see her subsequently for two years, when she brought to me her two brothers, one of them a physician, sixty-one years of age, and the other a coffee plantation owner, aged fifty-seven. The result of the operation on herself having remained so perfectly satisfactory, she wished that her two brothers should enjoy similar happiness.

In her case in fact, the fat had completely disappeared, her gait was light and youthful; her movements were graceful and her face might easily be taken for that of a woman of thirty-five, whereas she confessed to fifty!

When I asked her if she had again found happiness with her husband she replied without hesitation:

"No, I have not returned to my husband — he did not deserve it!"

I am not telling here a whimsical story, this narrative is absolutely true, and I draw from it the conclusion that, in the future, husbands would perhaps do well, instead of repudiating wives who have reached mature age, to consult, in their own country, some surgeon, who is able to rejuvenate them by grafting.

I have received touching letters from several of my patients confirming the happy change resulting from the implantation of a young ovary in their organism. I will quote an extract from one only, which I received from an English lady, and which is characteristic of woman's mind, woman's natural coquetry, and the value which she attaches to certain expressions of youth:

> "I told you two months ago that, although my friends said that I was looking better, nobody had remarked that I was younger. Now, however, they are beginning to say so, and several have told me that, in spite of my grey hair, I have a youthful face. A real alteration has now begun to manifest itself, and I really observe that I am changing little by little. My lips are redder and less thin than before; the vertical wrinkles around my nose and mouth are much less conspicuous. I can state definitely that my memory is much better."

CHAPTER THIRTEEN

The Future of Human Grafting

WE HAVE now studied the effects on the organism of interstitial gland grafting. Can this method be generalized? Shall we be able to submit our bodies, in an operating room, to a treatment that can be compared with the repair, made in a workshop, of a machine of which one or more parts are worn out?

Evidently the conditions in the two cases are not the same. We not only do not know how to construct the human machine, but we are not even capable of fabricating the least of its organs. Before I had discovered an immense stock of spare parts in the bodies of the higher monkeys, it was but rarely possible to resort to grafting for the repair of a lesion of the body.

For bones the problem is simple enough. We have retained from primitive times a bone which was useful for tree-climbing; but, since we now scarcely ever indulge in this form of exercise, it is of very little service to us. Therefore it may be removed without causing us any damage, so far as standing and walking are concerned. Running animals, like the horse and the dromedary, the ancestors of which were also running animals, possess this bone only in a very rudimentary form. It is the fibula, the small bone of the leg, which is found alongside of the tibia, or shin-bone. The latter is sufficiently sturdy to do without the help of its neighbor.

When we have to fill in a gap in one of our bones — and such cases happened frequently during the war, to say nothing of their being still met with quite often enough as the result of various kinds of accidents or diseases — it is easy for us to take a portion of the patient's own fibula and to adapt it between the two ends of the fractured bone. I had the good fortune to give many of our wounded the benefit of this method when called upon to repair large breaches in their skeletons. But even then, however, in order to avoid adding a fresh wound to their already more or less battered bodies I resorted, in such cases, to the bones of monkeys.

The first wounded man who benefited from this method of treatment owes it to M. Raymond Poincaré, then President of the Republic, who caused the only chimpanzee which the Zoölogical Gardens then possessed, to be sent to me to Bordeaux. Afterwards, I received further living material from our colonies, and I made a large use of it in the first bone-grafting hospital founded in Paris — Auxiliary Hospital No. 197, Rue d'Armaillé, which was generously endowed by M. Coty, Director of the "Figaro", and of which the direction was entrusted to me.

We can also find on the patient himself the necessary material for grafting, when a torn tendon has to be replaced. We possess tendons sufficiently large to enable us to make loans of this kind, and such spare parts can also be taken from the broad and unyielding membrane which covers over the muscles of our abdomen.

Skin may also be replaced without great difficulty, by taking some from a concealed part of the body, for the benefit of some visible portion, or — as it occurred to us in the case of a young girl who had been horribly burned on the face and hands — by employing as grafting material the foetal membranes which envelop an infant at birth.

It is fairly easy, again, to replace a portion of artery, in the case of an aneurism, when the wall of the affected vessel has become so thin that it is ready to burst — an eventuality that must inevitably bring about the death of the sufferer. In such a case arteries are used which have been removed from bodies immediately after death and which have been preserved in refrigerators, in readiness to be utilized at any moment.

The same method may be applied when we have to replace a whole joint which has been destroyed. On June 4, 1910, Kuttener replaced a knee joint that had been destroyed by a tumor, by a similar articulation that had been removed, three hours after death, from another patient in his hospital, and preserved for twenty-four hours in a refrigerator. He was able to satisfy himself on June 19, 1911, a year after the operation, that the patient, who had returned to his home six months before, could stand upright without support, could walk without having to wear any form of orthopedic appliance, and perform, with his borrowed knee, every movement of flexion and extension. On December 18, 1915, I presented before the Paris Biological Society some dogs which walked with joints that had been grafted into them fifteen months before.

Nerve trunks may be utilized in the same manner for the replacement of those which have been destroyed, and it is thus now possible to cure cases of muscular paralysis due to such lesions, as was done during the war by the celebrated surgeon Gosset. We had the occasion to practise this operation ourselves in 1906, on a young Egyptian Arab, whose ulnar nerve had been severed in a shooting accident.

The difficulties are greater, but they are not insurmountable when it is desired to transplant an internal organ. Thus it has been found possible to graft ovaries on a sterile woman, or one who had been surgically deprived of those organs, by borrowing the material to be grafted from another woman, in the course of an operation for the removal of the womb, the ovaries being taken out at the same time. Valuable as it might be, in the latter case, to preserve a portion of the ovaries in order to maintain vital energy, a woman can, without prejudice to herself, sacrifice one of these glands for the benefit of one of her kin.

Morris has thus obtained a remarkable result. A white man's white wife in whom he had transplanted ovaries borrowed from a mulatto, gave birth, fourteen months after the operation, to a mulatto child, weighing seven and a half pounds.

I have already cited a case in which we implanted into an ewe, after having removed its ovaries, those of another ewe born from the same mother, with the result that the former gave birth to a lamb which came from a beast the ovaries of which did not belong to it.

When it is a question, not of combatting sterility, but of restoring the vital forces and rejuvenating an organism enfeebled by age, it is not at all necessary to borrow the required ovary from another woman. The ovary of a female chimpanzee gives exactly the same result.

Grafting of the kidney has not yet been carried out in the case of a man; and yet, in certain cases, the grafting of this organ can, alone, save the patient. Thus it is possible to cope with tuberculosis of the kidney by removing the diseased organ; but, then, if the second kidney becomes affected in its turn, the substitution of another kidney is the sole means of avoiding a fatal issue. The kidney of a healthy man killed by accidental means and which has been removed from the corpse immediately after death, could be used in such a case.

Would the kidneys of the higher monkeys be utilizable in such circumstances? The future will show. What is certain is that such a graft is perfectly possible. Carrel has realized it on cats and dogs, and I have done the same on some small donkeys which were sent me from Corsica.

I had a splendid opportunity to perform this operation on a human being, but, unfortunately I was prevented from attempting it. The circumstances which caused this disappointment are worth relating.

It will be remembered that during the trial of the Bonnot gang of motor-bandits, Raymond-la-Science, one of the men, who was sentenced to death, asked that his body should be handed over to science before being handed to the executioner. I had as one of my patients, at that time, a young girl of nineteen, who was of rare beauty. She had already been deprived of one kidney some years previously, as the result of tuberculosis. Her second kidney became affected, and her death within a short time was inevitable. Through the intermediary of a lawyer, I approached the President of the Republic, begging him to authorize me to remove a kidney from Raymond-la-Science, in order to transplant it to my young patient. The reply received was that it was impossible to grant my request. If Raymond-la-Science should die under the operation, there would be an outcry that he had been cruelly treated, but, if he survived and the youthful patient was saved, it would be still worse. The assassin would then become a benefactor, something which is against all existing rules.

Raymond-la-Science was executed and the young girl died. This tragic story convinced me that the future of grafting does not lie in the necessary grafts being borrowed from men, and I am glad to have found the source of supply which monkeys offer us.

Opotherapy, which consists in administering extracts of animal glands when our own are deficient, constitutes a palliative treatment, and is of little efficacy. The action of all our glands goes on uninterruptedly and their secretion is in proportion with the needs of our organism. The administration of glandular extracts, whatever may be its mode and the form of the remedy cannot play an analogous part: no one can take a medicament throughout the whole day and throughout the whole of life.

At a date which is not yet very far distant, opotherapy was a notable progress in the treatment of a great number of human afflictions, but, nowadays, we can do better. Opotherapy is a thing of the past: the graft belongs to the future. In proportion as we better know more of our body, and as we are getting more daring our range of action is continually extending.

Surgery has reached its culminating point in the art of depriving us of many of our organs, thus curing the evil from which we suffered; but, in so doing, it often despoils us of a function formerly all-important in our organism. Operations save life, but they often leave us with less resistance.

The ideal towards which all our efforts must tend is to replace whatever has been taken away and to restore to the body the organ of which we have deprived it, for nothing in our body is superfluous. One may live without a kidney, or without a stomach, but life, under these conditions is not gratifying. The surgeon is proud of the brilliantly executed operation, the patient is delighted to have escaped death; but the life of the individual suffers from it and is diminished by it.

Let us leave to the surgery of our fathers the rôle which it will always fulfil, namely, to rid us of tumors, of suppurations, etc., but the new surgery, born of yesterday has a much vaster field of action.

This surgery of the future is the grafting of our organs, of our tissues, of our glands. The route has already been marked out by the pioneers of the earliest hour: Carrel, Dartigues, Euselberg, Harm, Knud Sand, Kuttner, Kespinasse, Lexner, Lydston, Maranan, Marro, Mauclair, Morris, Parragon, Penda, Pezard, Steinach, Thoreck, Tuffier, Georges Voronoff, Walker, and Zavadowsky.

Rooted as is routine, difficult as it is for the human mind to free itself from the fetters of prevailing ideas, the new method will finally assert itself.

As far as the interstitial and thyroid glands are concerned grafting has already become a reality.

We have a horror of decrepitude, of the infirmities of old age. Before reaching it we have all tasted the joys which an active life, overflowing energy and the intense ardor of our sentiments procured us in our youth.

Now, just at the period when acquired experience permits us to discern the mistakes we made and the acts which time has justified, just at the moment when our minds are ripe for great and valuable work, our capacity for labor abandons us. Memory weakens, thought becomes inactive, all effort becomes a hardship.

We grow old too soon; we die before we have accomplished our task.

To give new energy to the men whose value has grown with age, whose minds have become rich in accumulated knowledge; whose souls have been mellowed by contact with all the sufferings felt or witnessed during their long existences, to render them apt for productive labor, is accomplishing a work of social usefulness; it is contributing to the progress of humanity.

Those who, in the grafting of the interstitial gland, which intensifies *all our energies*, see only a renewed source of certain enjoyments which end with age, have seen only the minor side of the problem. The question has a broader and higher application.

The grafting of this gland will contribute not only to the conservation of the human race and of the races of animals the lives of which we have so much interest in intensifying, but also to the permanence of our intellectual capacities and our aptitude for labor. The ideal towards which all our efforts are tending is to preserve life with the plenitude of its physical and intellectual manifestations, to abridge the duration of old age, to put off Death to the last limit LIVE YOUNG!

09-BTG-797